Diesel Power

& Diesel Transportation

Multi-Fuel Engines

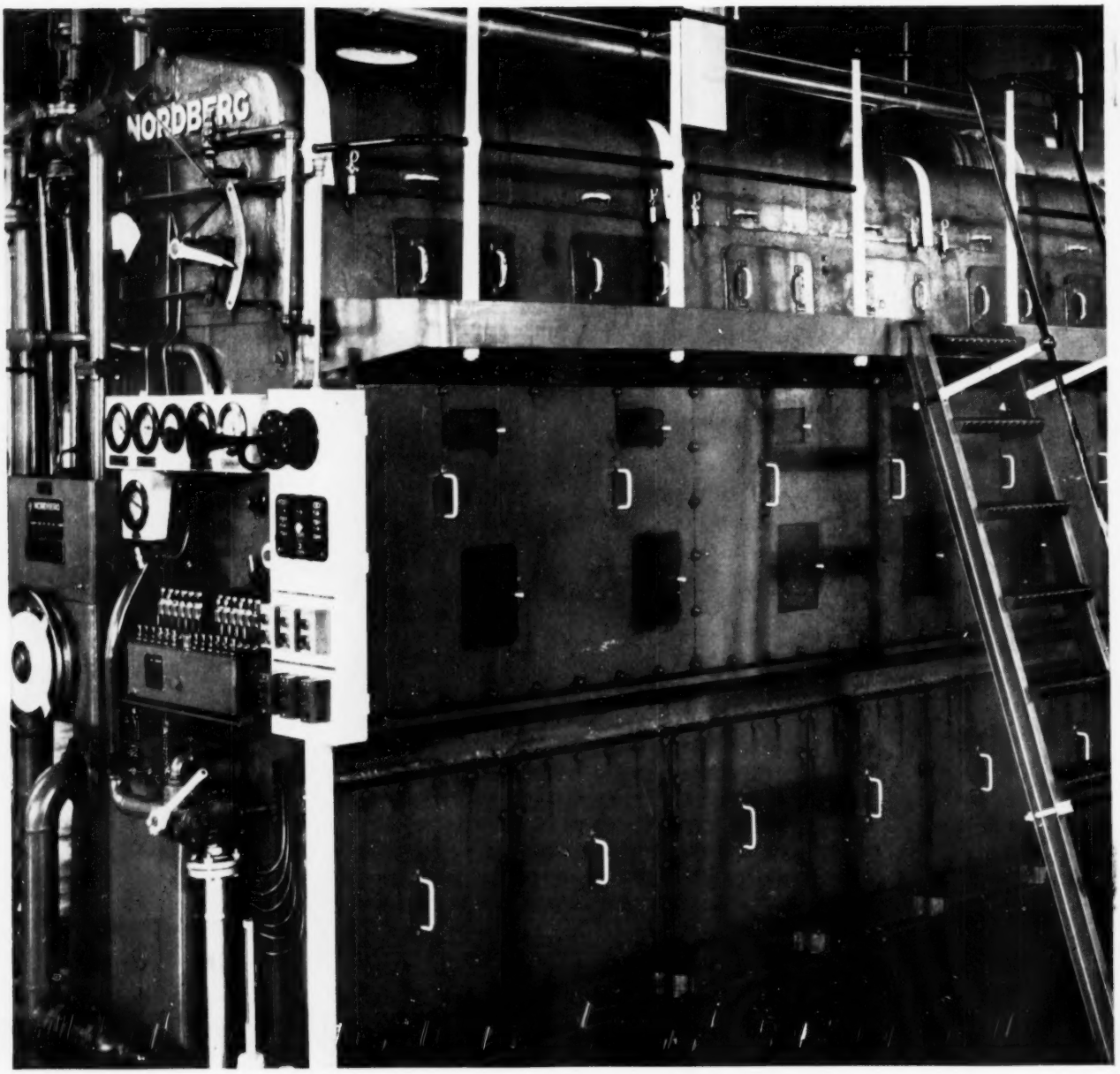
.. Texas Co. Cycle

.. Air Force Development

Our 29th Year

MAY, 1951

ASSURE THRIFTY



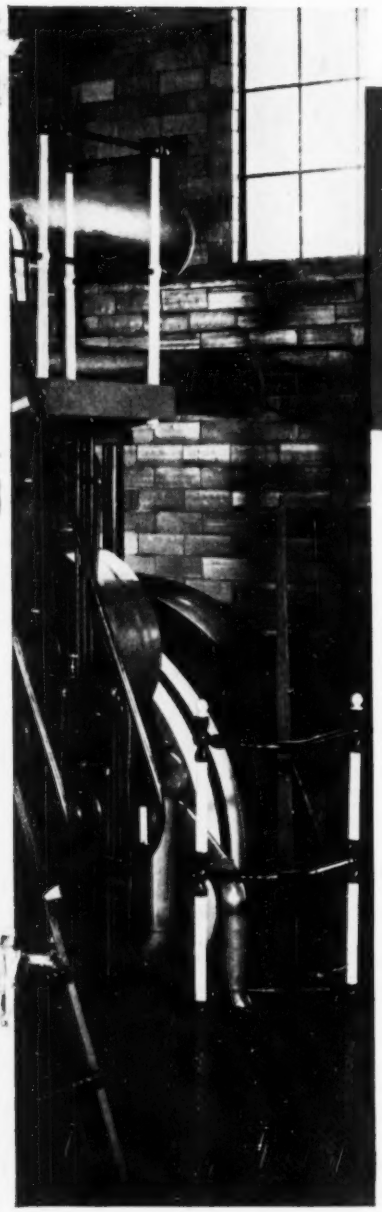
TUNE IN . . .
TEXACO STAR THEATER
starring
MILTON BERLE
on television
every Tuesday night.
See newspaper for
time and station.

TEXACO

TEXACO

DIESEL POWER and DIESEL TRANSPORTATION for May, 1951, Vol. XXIX, No. 5. It is published monthly by Diesel Publications, Inc., Orange, Conn. Executive and Editorial offices 192 Lexington Ave., New York 16, N. Y. Subscription rates: United States, $3.00 per year, single copies 35¢; Canada $4.00; Foreign $5.00 per year. Entered as second class matter April 29, 1949 at the Post Office, Orange, Connecticut, under Act of March 3, 1879.

POWER



Lubricate your engines with TEXACO URSA OILS

When you use *Texaco Ursa Oils* in your Diesel, gas or dual-fuel engines, you get full power *plus* real economy. *Texaco Ursa Oils* assure this because they resist oxidation, stand up under heat and pressure and keep engines clean . . . free from harmful sludge and carbon.

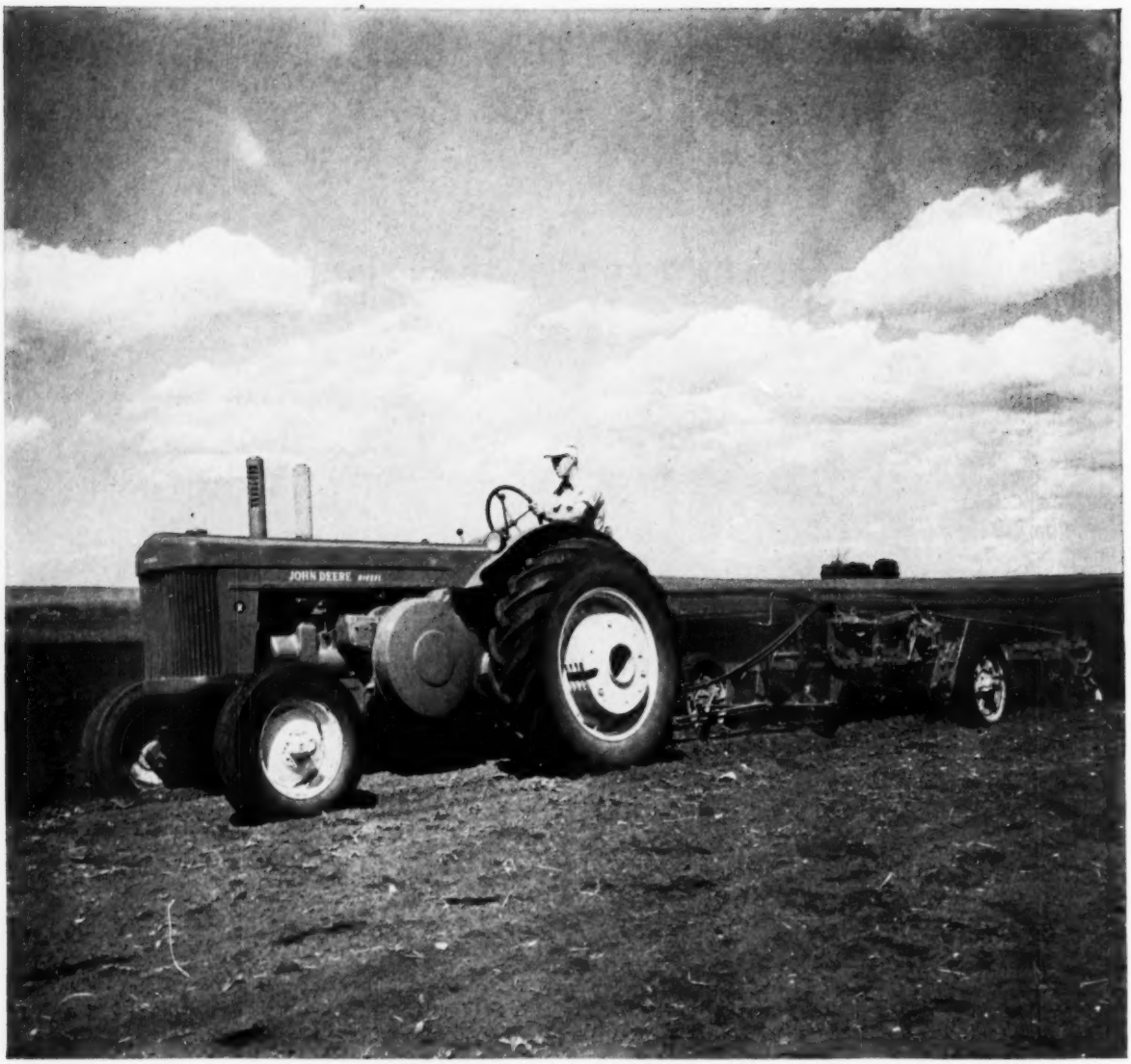
This means free rings, open ports and properly functioning valves for better compression and combustion—less fuel consumption. Wear is reduced . . . bearings and all moving parts last longer . . . maintenance costs go down.

Texaco Ursa Oils are available in every needed viscosity and are approved by leading engine manufacturers. Their fine performance has made them America's favorite. In the Diesel field alone—

More stationary Diesel h.p. in the U. S. is lubricated with Texaco Ursa Oils than with any other brand.

A Texaco Lubrication Engineer will gladly help you protect your Diesel investment with effective lubrication. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

URSA OILS FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES



John Deere, Model R Diesel Tractor with gang-plow . . . Power-Protected by Purolator

Where the Deere and the gang-plow roam...

Wherever soil is worked—on range or "lone prairie"—there's bound to be dust.

And where there's dust, there's engine-trouble—that is, unless engines are given real *power-protection!* To make engines last longer, perform better, manufacturers and operators rely on the Purolator* Micronic.

This modern unit traps abrasives measured in microns (.000039"); has a revolutionary accordion-pleated refill which provides a filtering area as much as 10 times that of ordinary filters; won't warp or disintegrate.

For lube oil, the Purolator Micronic* assures less wear on hard-working bearings and other vital parts.

For fuel oil, this means complete filtration, so essential because of close tolerances of injector orifices.

Whatever your filtering problem, let our engineering staff show you how to solve it!

*Reg. U. S. Pat. Off.

Protect your Power with...

PUROLATOR PRODUCTS, INC.
Rahway, New Jersey and Toronto, Ontario, Canada
Factory branch offices: Chicago, Detroit, Los Angeles

PUROLATOR
MICRONIC OIL FILTER
"FIRST IN THE FIELD OF FILTERING"

Announcing

4 NEW G-E TRI-CLAD SYNCHRONOUS GENERATORS

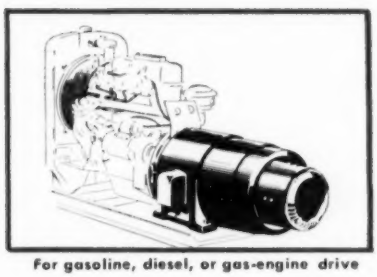
REG. U.S. PAT. OFF.

RATINGS—1.875 TO 50 KVA

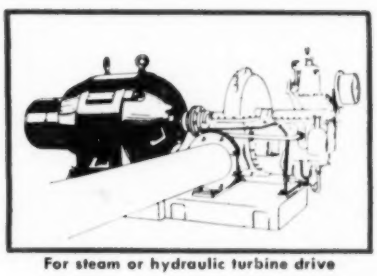
FREQUENCIES—60 AND 400 CYCLES

Four Basic Designs to Choose From—to "custom-fit" the generator to YOUR job

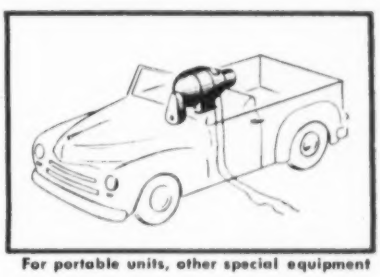
- **Externally regulated 4-pole**
- **Self-regulated 4-pole**
- **Packaged regulated 4-pole**
- **High-frequency 14-pole**



For gasoline, diesel, or gas-engine drive



For steam or hydraulic turbine drive



For portable units, other special equipment

Here's why these new generators are your best power buy—

DEPENDABLE, EFFICIENT—including Tri-Clad's famous "triple protection".

EASY TO INSTALL—space-saving Tri-Clad design makes installation easy.

FLEXIBLE—lightweight construction is well suited to portable installations.

EASY TO MAINTAIN—Tri-Clad lubrication system makes relubrication easy, but seldom needed.

From aircraft ground power to telephone exchanges, these new G-E Tri-Clad synchronous generators fit hundreds of applications. See your G-E sales representative, he'll be glad to discuss your particular application. Or for more information, write for GEA-5470. *Section 765-1, General Electric Co., Schenectady 5, N. Y.*

Here are just a few of the places where these Tri-Clad generators give outstanding service—

- airports
- marine operations
- construction projects
- mining operations
- industrial plants
- mobile applications
- pumping stations
- refineries
- shipyards
- municipal power

GENERAL ELECTRIC

765-1

TWO FAMOUS NAMES
an expanded line

HAMILTON

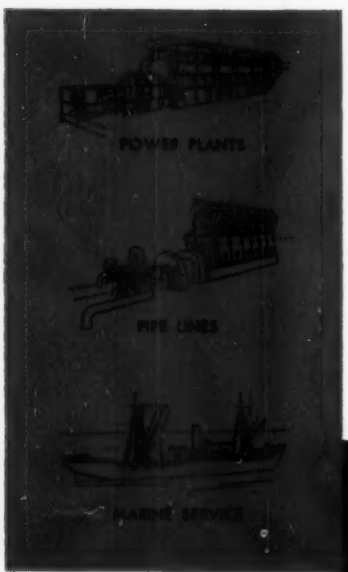
BALDWIN
DE LA VERGNE

If your power-needs fall anywhere within the medium speed range from 275 to 6860 horsepower, you'll find there's a conservatively rated, service-certified B-L-H unit ready to do virtually any job. The famous Hamilton Diesel line has now been expanded by the addition of the Baldwin-De La Vergne 600 Diesel series, which has been setting impressive records in fuel economy and overall performance.

The integration of the line has brought other advantages with it of equal importance to you. Engineering experience has been pooled; this brings an expanded opportunity for research and development. Manufacturing facilities have been consolidated; this permits more effective operation, increased output, and improved deliveries. Purchasing, planning, production and sales operations have been coordinated—with the increased efficiency that unit control effects.

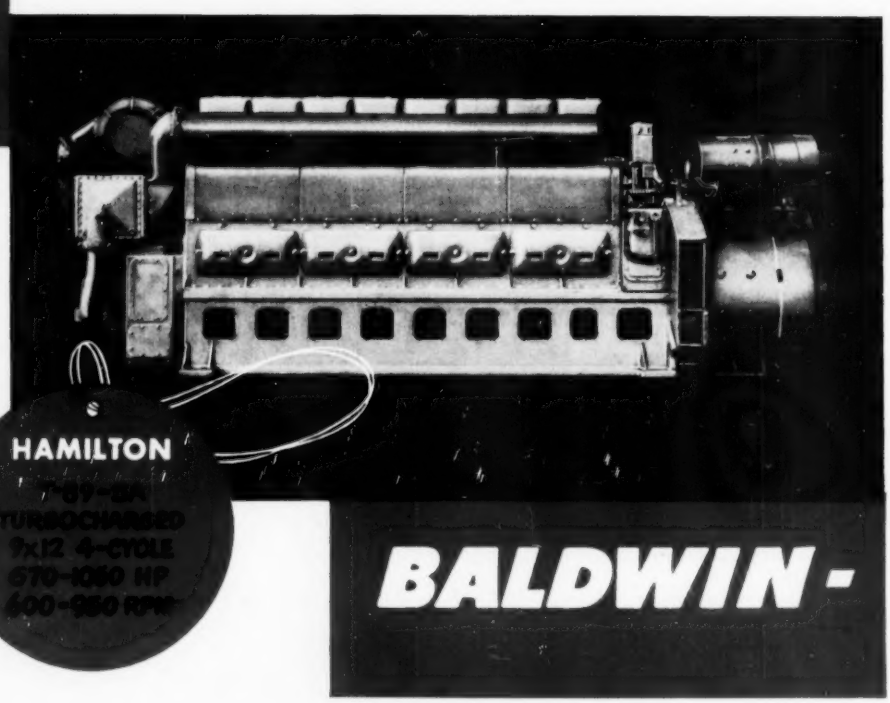
You'll find every thing you liked about the old lines has been retained . . . with new things added that you'll appreciate.

LIMA-HAMILTON DIVISION
HAMILTON, OHIO



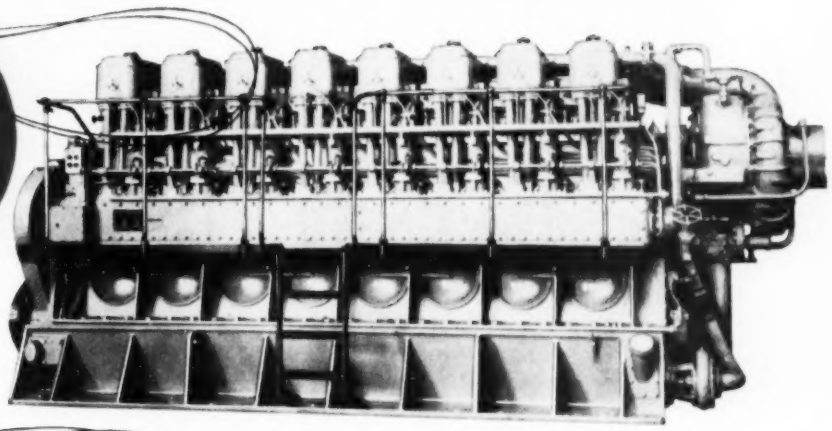
Low weight per horsepower, high efficiency over a wide range of output, and built-in dependability, are inherent characteristics of every B-L-H engine, assuring top performance in every application either as straight Diesel, or dual-fuel.

HAMILTON T-69-SA and T-89-SA 4-cycle, 9 x 12 turbo charge cover a range from 500 to 1060 h.p. at 600 to 950 rpm. These ruggedly-built units are especially adapted to stationary and marine applications.



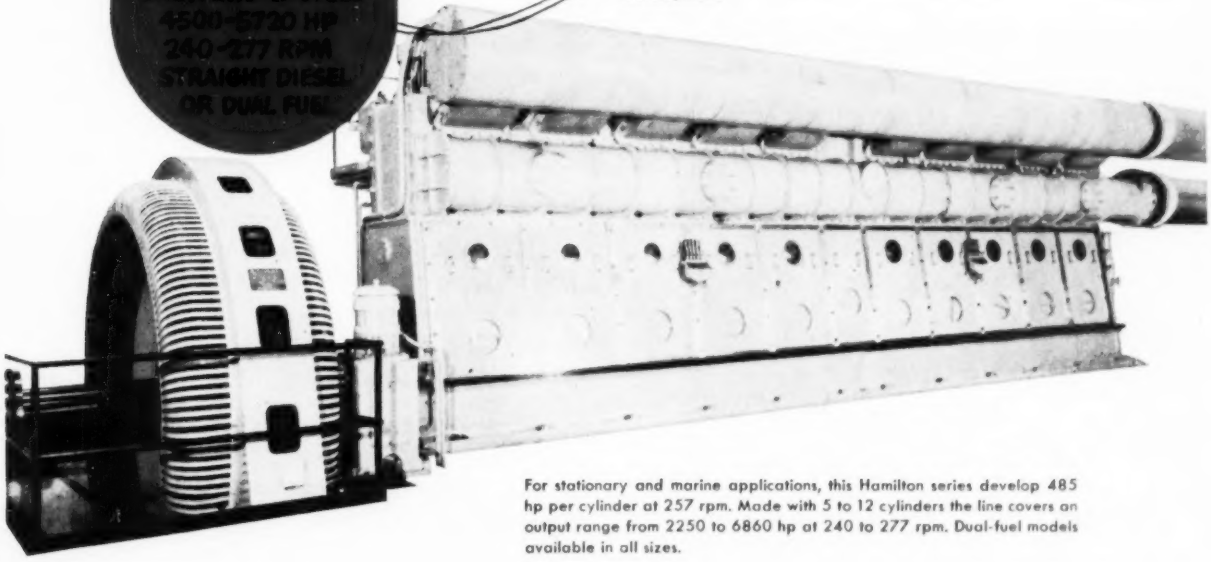
ARE JOINED to give you of Modern Diesel Power

BALDWIN
DE LA VERGNE
606-SC
SUPERCHARGED
12.75 x 15.5 4-CYCLE
865-1500 HP
360-625 RPM



BALDWIN-DE LA VERGNE 600 SERIES with 6 or 8 cylinders and available either normally aspirated or super-charged, provide a power range from 430 to 1500 hp at 360-625 rpm. The new-type, high pressure turbo-charger permits operation up to 8000-ft. altitude. Dual-fuel units under development.

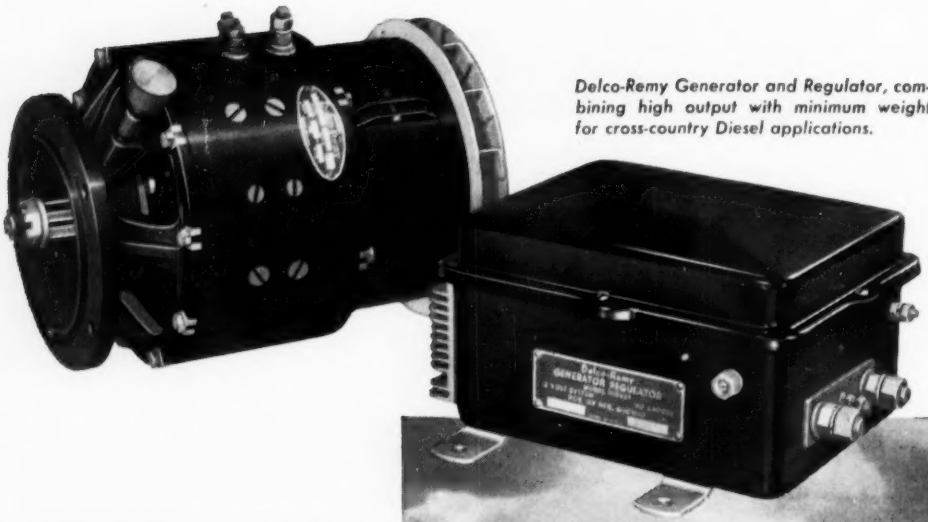
HAMILTON
12H-SA
21.5 x 22.5 2-CYCLE
4500-6720 HP
240-277 RPM
STRAIGHT DIESEL
OR DUAL FUEL



For stationary and marine applications, this Hamilton series develop 485 hp per cylinder at 257 rpm. Made with 5 to 12 cylinders the line covers an output range from 2250 to 6860 hp at 240 to 277 rpm. Dual-fuel models available in all sizes.

LIMA-HAMILTON
Offices in Principal Cities

BALDWIN BLH LIMA-HAMILTON



Delco-Remy Generator and Regulator, combining high output with minimum weight for cross-country Diesel applications.

SERVING THE DIESELS THAT SERVE AMERICA . . .

DELCO-REMY

Modern, economical Diesel engines provide the power that carries America's travelers from town to town in many of today's supercoaches. And, on many Diesels Delco-Remy electrical equipment supplies the electrical needs.

The Delco-Remy name means much to the producers and users of Diesel equipment . . . it means outstanding performance under all conditions . . . dependable operation that helps to keep Diesels on the job.

UNITED SERVICE MOTORS

DELCO-REMY—A UNITED MOTORS LINE
Service Parts and Delco Batteries Available Everywhere Through UNITED MOTORS DISTRIBUTORS

Delco-Remy
DIVISION OF GENERAL MOTORS CORPORATION
ANDERSON, INDIANA

DELCO-REMY • WHEREVER WHEELS TURN OR PROPELLERS SPIN

better diesel performance

from better bearings!

COPPER-LEAD BEARINGS TO MEET EVERY DIESEL OPERATING NEED

We have developed a range of special Diesel Copper-Lead alloys that meet nearly every performance requirement, from truck engines to large railroad and marine applications. Each alloy is tailored to a specific range of usefulness. For example, Federaloy H-24 and H-35 meet requirements within the high speed truck and tractor field, while Federaloy B-40 is turning in top performance records on railroad Diesels.

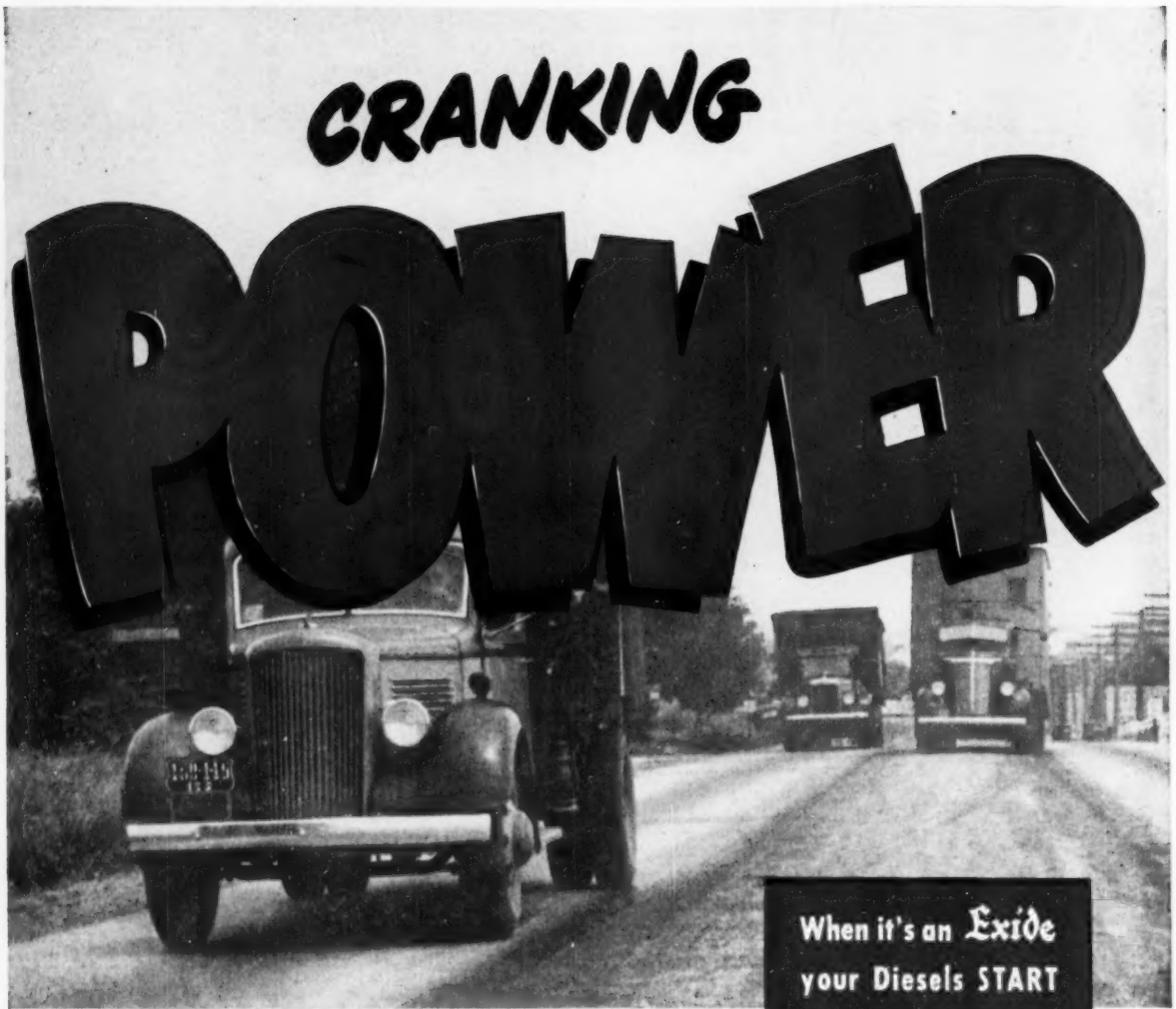
Whether you are faced with a new Diesel bearing design, or a re-design job . . . or a real operating problem, why not get the experienced opinions of our engineers? They know the field and are glad to help.

FEDERAL-MOGUL CORPORATION, 11041 Shoemaker, Detroit 13, Michigan

SINCE 1899

Our six plants produce sleeve bearings in all designs and sizes; cast bronze bushings; rolled split-type bushings; bi-metallic rolled bushings; washers; spacer tubes; precision bronze parts and bronze bars.

FEDERAL-MOGUL *Copper-Lead* **DIESEL BEARINGS**



Day after day, in all climates, you can count on Exide cranking power

Exide Diesel Batteries are built specifically for heavy duty cranking jobs. They're a product of close cooperation of engine and starter builders and Exide research-engineering. Test after test, under the most exacting conditions, assures dependable starting in all types of Diesel-powered equipment. Exide Diesel Cranking Batteries give you:

HIGH MAINTAINED VOLTAGE for a *quick breakaway* and *high cranking speeds.*

EXTRA LONG LIFE—low depreciation, less frequent replacements.

LOW COSTS—operation, maintenance, repair.

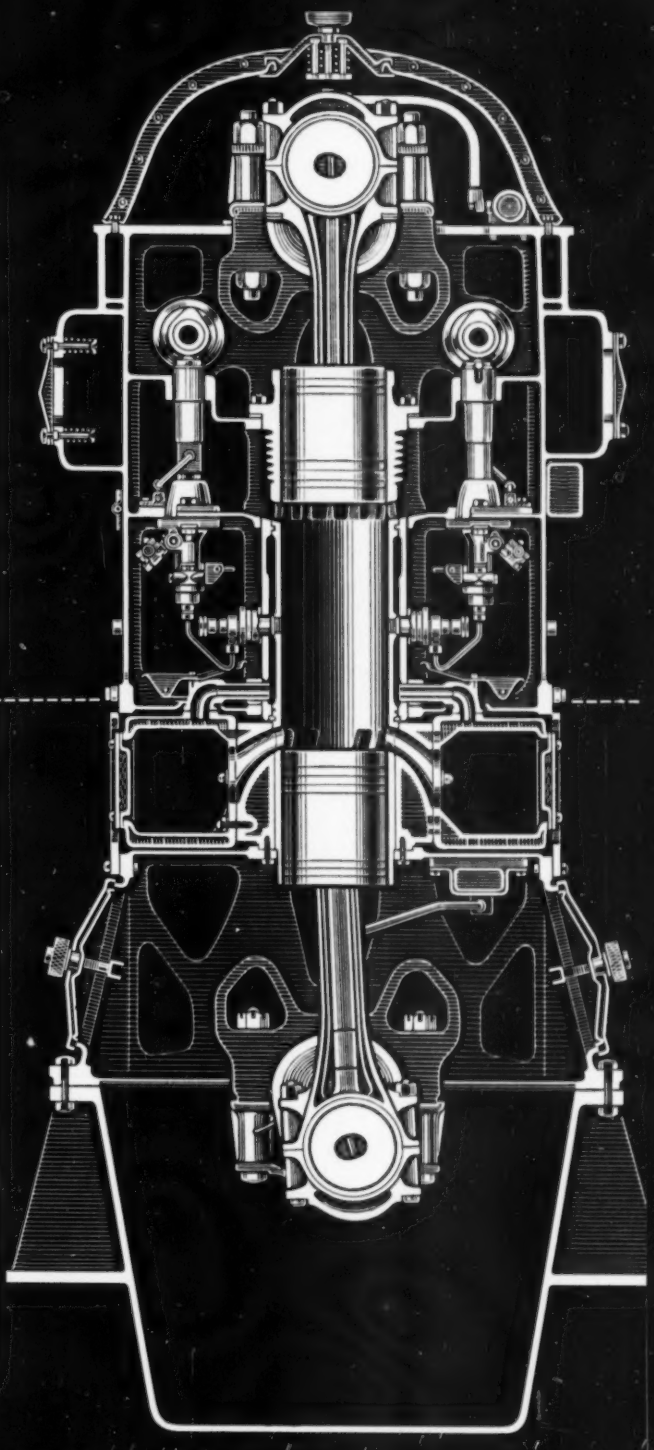
RUGGED CONSTRUCTION for rough usage and hard service.

Use Exide Diesel Cranking Batteries for all heavy-duty equipment . . . buses, trucks, tractors, off-the-highway equipment, ships, aircraft, power plants, Diesel-electric locomotives.

THE ELECTRIC STORAGE BATTERY COMPANY
Philadelphia 2
Exide Batteries of Canada, Limited, Toronto
"Exide" Reg. Trade-mark U. S. Pat. Off.

1888
DEPENDABLE BATTERIES FOR 63 YEARS
1951

Cross-Section of Over 5,000,000 Horsepower...



This cross-section of an Opposed-Piston diesel engine tells why, in a few short years, over 5,000,000 hp. of engines of this design have been placed in service—for low-cost public power generation, for propelling surface and undersea craft, and as prime movers of the railroad world's newest and finest diesel locomotives.

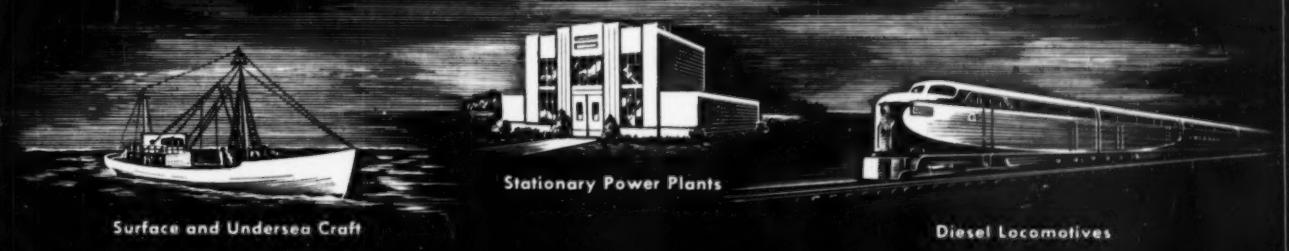
Note the design that underlies the immediate and continued success of this great engine: with TWO pistons in each cylinder—driven apart by a central combustion—the Opposed-Piston engine delivers more power per cylinder, more power per foot of floor space, more power per gallon of fuel. All this, plus the advantages of less weight, less vibration, 40% fewer moving parts. Fairbanks, Morse & Co., Chicago 5, Ill.

FAIRBANKS-MORSE,

a name worth remembering

DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY • PUMPS • SCALES • HOME WATER SERVICE EQUIPMENT • RAIL CARS • FARM MACHINERY

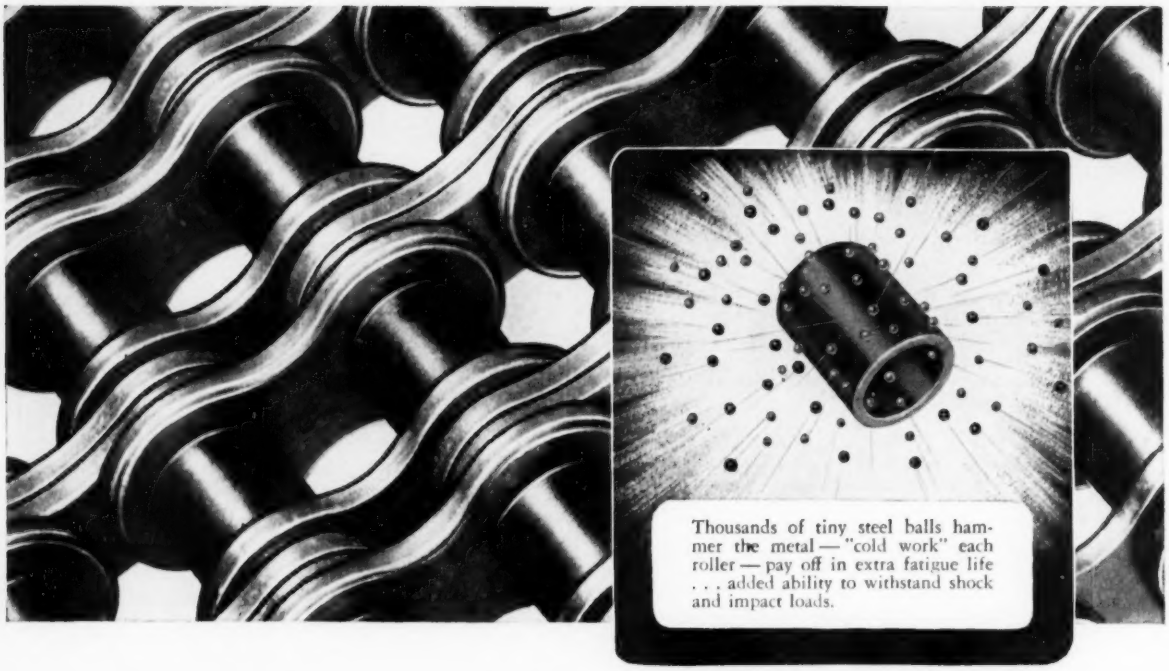
POWERED by Fairbanks-Morse Opposed-Piston Diesel Engines—up to 2400 hp.



Surface and Undersea Craft

Stationary Power Plants

Diesel Locomotives


Thousands of tiny steel balls hammer the metal — "cold work" each roller — pay off in extra fatigue life . . . added ability to withstand shock and impact loads.

Why you should be sure the roller chain you buy has

SHOT-PEENED ROLLERS

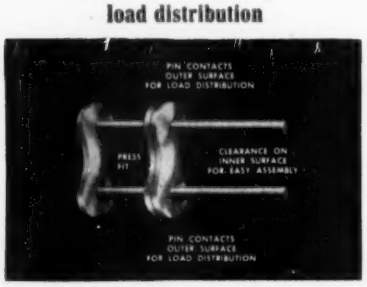
. . . one of the extra-strength features you get with every LINK-BELT Roller Chain

LOOK for the distinguishing darkened rollers on every roller chain you buy! They're your guarantee of extra fatigue life.

Shot-peening is just one of the added manufacturing refinements that make Link-Belt Precision Steel Roller Chain a longer-life chain. Controlled material selection and heat treating assure absolute uniformity . . . no weak members.

Link-Belt Roller Chain is available in single or multiple widths, in ⅜ to 3 in. single and double pitch. For the best in roller chain, get in touch with your nearest Link-Belt office.

Easier coupling and uncoupling without sacrificing load distribution


PIN CONTACTS OUTER SURFACE FOR LOAD DISTRIBUTION
PRESS FIT
CLEARANCE ON INNER SURFACE FOR EASY ASSEMBLY
PIN CONTACTS OUTER SURFACE FOR LOAD DISTRIBUTION

Patented E-Z Assembly feature of Link-Belt Precision Steel Roller Chain has won world-wide approval. Coupling and uncoupling of multiple width chains—right on the job—is far easier. There's absolutely no sacrifice of load distribution . . . no loss of the chain's remarkable performance. Press-fits between chain pins and middle bars have been modified. But full load-carrying capacity across the entire width of the chain has been maintained.

LINK-BELT

PRECISION STEEL ROLLER CHAIN

LINK-BELT COMPANY: Indianapolis 6, Chicago 9, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa). Offices, Factory Branch Stores and Distributors in principal cities. 12.333

"Buffalo" EVAPORATIVE COOLERS

— DURABLE "PACKAGE" UNITS FOR CLOSED-SYSTEM *LIQUID COOLING*

QUALITY CONSTRUCTION THAT PREVENTS TROUBLE—

From installation on, "Buffalo" Evaporative Coolers save you money and trouble. In three basic sections (blower head, coils and tank), they can be moved in through ordinary doorways, and are simple to maintain. Fans are "Buffalo" hollow shaft "mixed flow" type—very quiet and efficient. Pumps for re-circulating the spray water are by "Buffalo". Spiral fin coils are by Aerofin. In every respect, you will find these units to be space-savers, water-savers and trouble-savers while doing an effective cooling job.

WRITE FOR BULLETIN 3666—

Check specifications and see how carefully built are "Buffalo" Evaporative Coolers, to give you better performance.

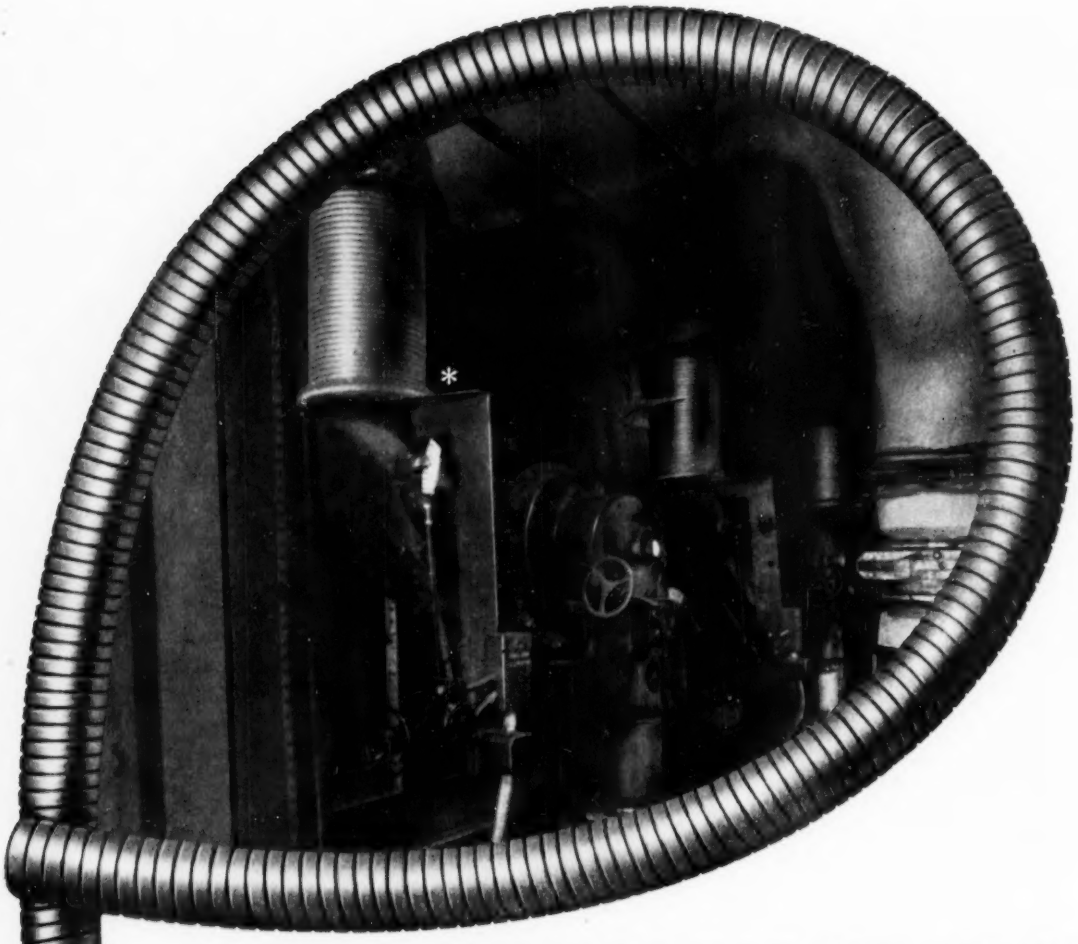
"Buffalo" FIRST FOR FANS

BUFFALO FORGE COMPANY

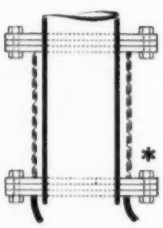
140 MORTIMER ST. BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont. Branch offices in all Principal Cities

EVAPORATIVE COOLERS AND AXIAL FLOW FANS FOR COOLING MOBILE AND STATIONARY DIESELS



HELPS "PIPE DANCE" IN BOILER OPERATION



(Cross-sectional view, showing Penflex tubing encasement on steel feed pipes from hopper.)

PENFLEX TUBING ABSORBS THERMAL EXPANSION

When a large public utility power plant fed powdered coal into burners of high-pressure steam boilers, thermal expansion moved steel feed tubes around, showering coal dust over equipment.

Penflex tubing was recommended as an outer protective encasement for the rigid steel tube that comes down from the hopper. Lengths of 20" & 24" I. D. interlocking, galvanized steel tubing were installed. Now the steel pipes from the hopper virtually "float" at one end when thermal expansion occurs. Penflex tubing forms a flexible seal between hopper and tube, assuring protected delivery of powdered fuel.

Let Penflex engineers help you on flexible tubing application problems. Penflex manufactures a complete line of four wall, interlocking and seamless welded corrugated flexible tubing . . . metallic hose, tubing or couplings from ⅛" I. D. and up . . . automatic barrel fillers, pneumatic rivet passers, accessories and fittings. Write for folder, "Flexineering," a valuable production aid.

Pennsylvania Flexible Metallic Tubing Company, Inc., 7236 Powers Lane, Phila. 34, Pa.
Branch Sales Offices: **Boston • New York • Chicago • Houston • Cleveland • Los Angeles**

Penflex

HEART OF INDUSTRY'S LIFE LINES

Copyright 1951 Penna. Flexible Metallic Tubing Co., Inc

Mobilizing Diesels

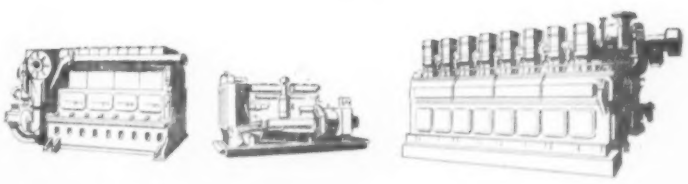
THE NATION wants peak production today. Much of the effort to achieve it must start at the source—with peak power output. So there's a big role to be played by Diesel engines. That points up an urgent duty of all those concerned with any Diesel operation: to re-examine not only their Diesel lubricants, but their entire Diesel lubrication practice!

Significant direct savings of oil can be made with the excellent lubricants Cities Service produces for all types of Diesels . . . for all operating conditions. But even more important is the power conserved . . . the saving of down-time—replacements—maintenance . . . and the improved production such savings permit.

A well-established way to make sure of Diesel lubrication that effectively contributes to peak power output . . . helps maintain it even under adverse conditions . . . is to consult a Cities Service Diesel lubrication specialist. He's fully qualified by intensive training and by wide experience with all types of Diesels. And he's readily available on request. Address CITIES SERVICE OIL COMPANY, Room 909, Sixty Wall Tower, New York City 5. Write. Or phone your nearest Cities Service office.

CITIES SERVICE

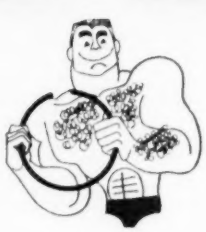
Quality Petroleum Products



CYCLAN

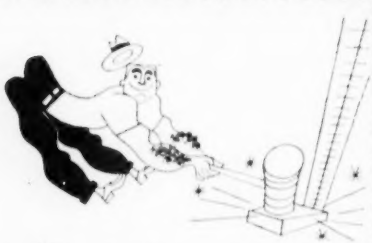
The new Piston Ring material for tough service in heavy duty Diesel and Gas Engines

1 *Cyclan* IS TOUGH, WITH PLENTY OF TENSION, BUT NOT BRITTLE

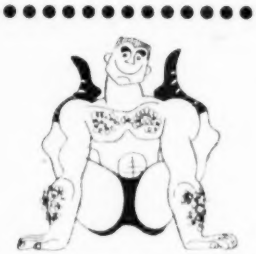


2 *Cyclan* HAS TWICE THE BREAKAGE RESISTANCE OF ORDINARY IRON

3 *Cyclan* RETAINS ORIGINAL TENSION UP TO 700° F.



4 *Cyclan* WITHSTANDS IMPACT, HAMMERING, AND FLEXING



5 *Cyclan* WITHSTANDS CONSIDERABLE DISTORTION WITHOUT LOSING SHAPE

6 *Cyclan* RESISTS WEAR FAR BETTER THAN STANDARD RING IRON

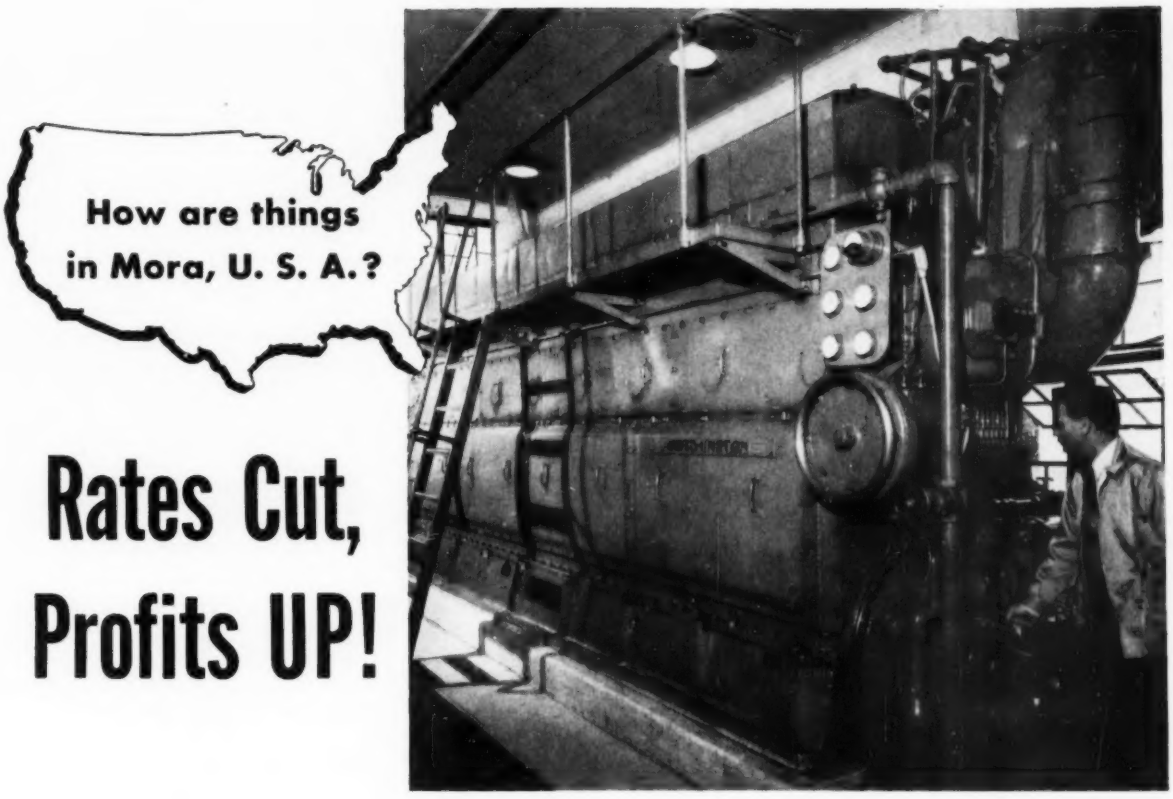
AVAILABLE FOR RINGS UP TO 9" DIAMETER.

Write for complete information

SEALED POWER CORPORATION
MUSKEGON, MICHIGAN

Sealed Power

PISTON RINGS · PISTONS
CYLINDER SLEEVES



Rates Cut, Profits UP!

Things are as good in Mora, Minnesota as the song says they are in Glocca Mora.

Worthington Diesel engines operated by the municipal power plant in this progressive community have helped produce the lowest electric rate of any full Diesel municipal power plant in the state.

A Worthington 4-cycle supercharged engine, operating at low load factor of 42.6%, produced in 1950 5% more power per gallon of fuel than a 2-cycle engine operating at 59.4% load factor. Following the installation of the Worthington engine, rates were cut in 1949, yet net profits, in 1950, were greater than ever.

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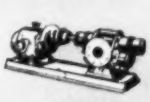
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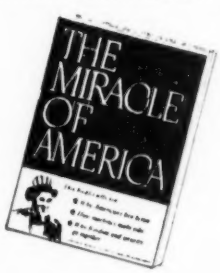

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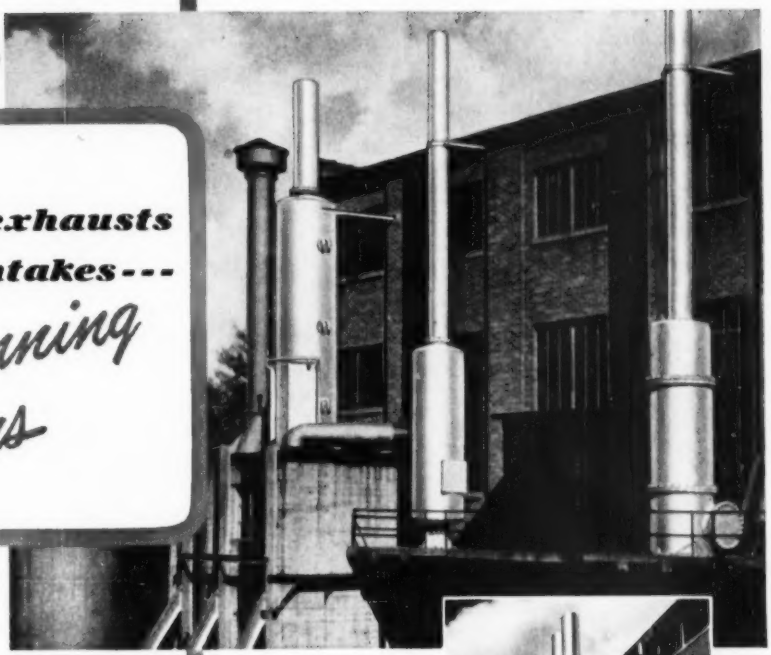

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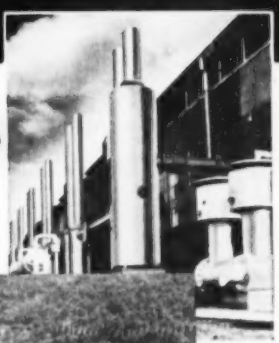

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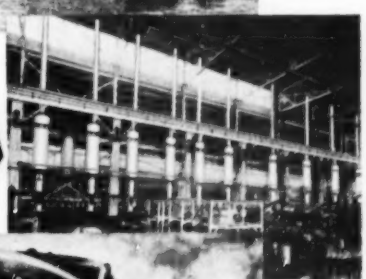

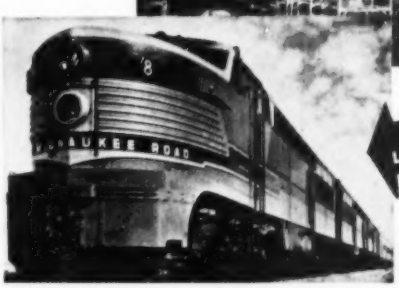

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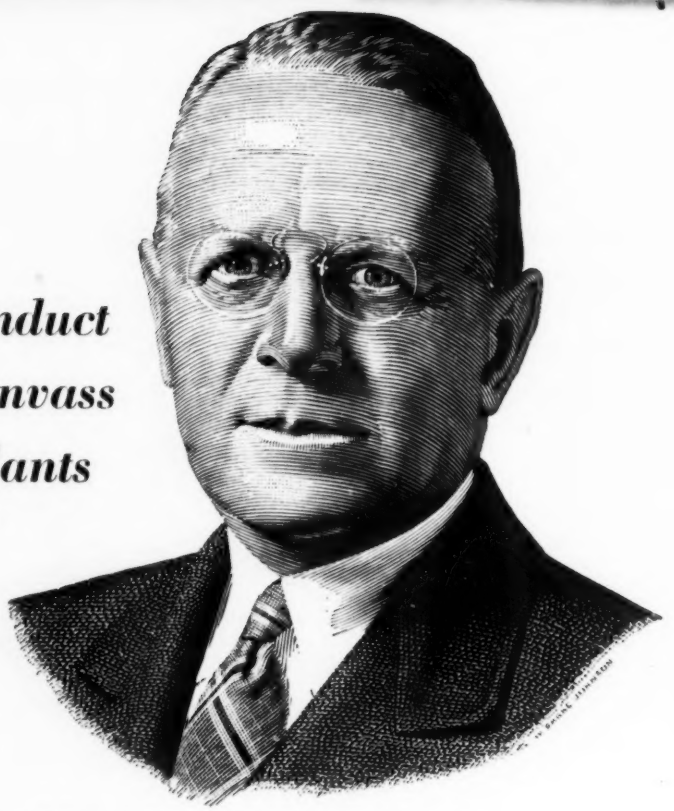

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Operator Louis Hyster working his International Harvester TD-9 right to the brink of a 250-ft. drop to the stone floor of the Cleveland Quarries, South Amherst, Ohio.

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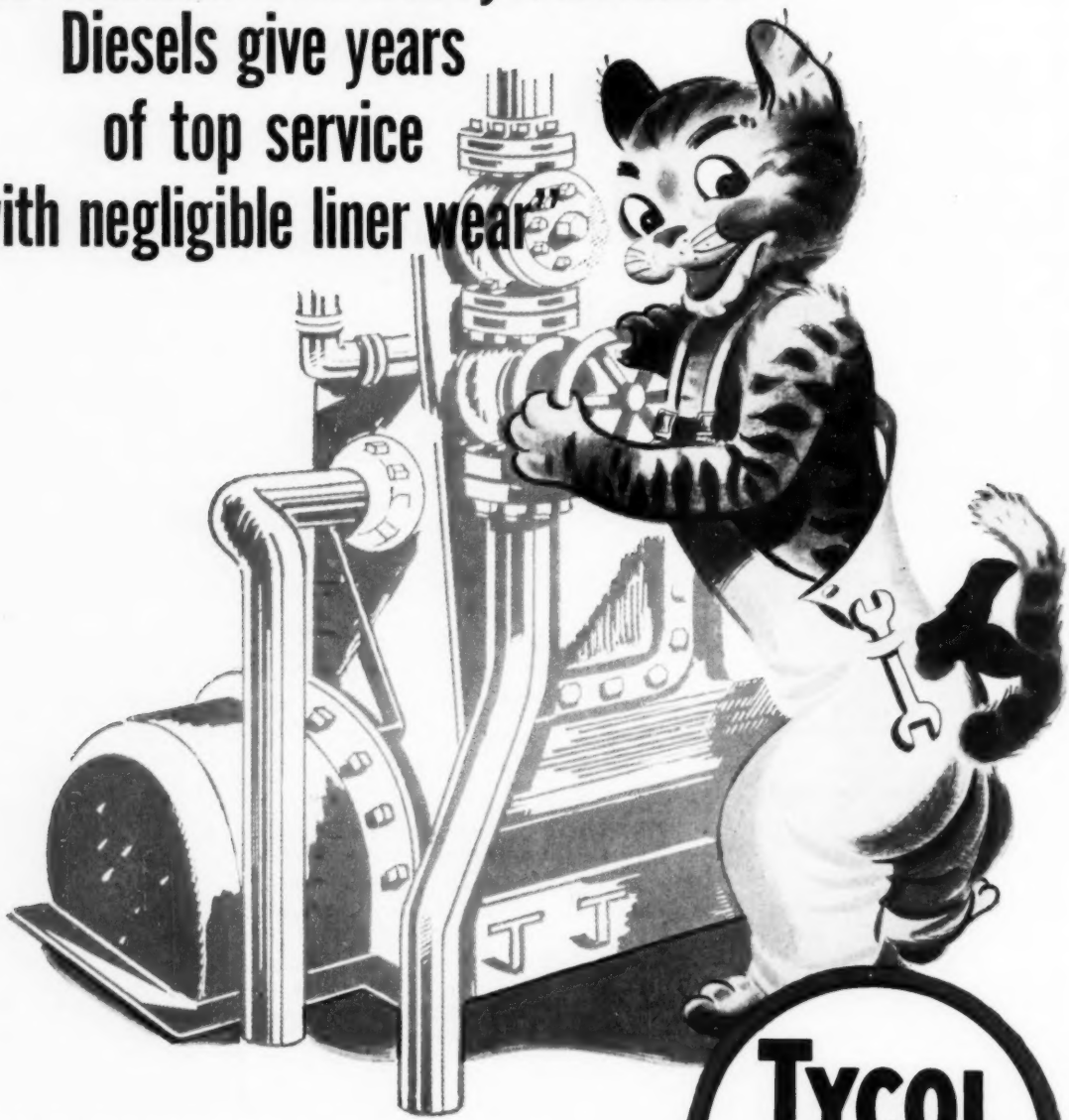

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Editorial:

Industry is Missing a Bet

INDUSTRY, particularly at this time, is preoccupied with matters of immediate concern and rightly so. There is a lot of engineering work to be done that is involved in production changes, substitution of materials, meeting specifications, etc., and as is usual in times of emergency, engineering talent is scarce. A year or two ago, engineers were looking for jobs as budget-minded management tended to cut overhead to the bone in view of the uncertainty of the times. Now, June engineering graduates should have a field day.

With engineering talent so thoroughly absorbed, what happens to the long range research and development programs? In many cases, this type of program is a luxury that many engine builders could not afford even in good times. In others, management took the short range view and concentrated all of their efforts on immediate problems.

We know of one case where an engine builder took a dim view of a proffered suggestion from an independent agency to the effect that the agency undertake some long range engineering projects for them. The attitude was that the firm was not interested in events ten years hence, but wanted results now. The "now" is important, of course, but as the problems of the moment were solved, utilizing all the engineering talent of the builder, the years were passing and new problems came up. Result? At the end of the ten year period, once in the dim future, the engine builder was still faced with the "now" problems and had no benefit of long range planning.

The agency mentioned above happened to be a university. Perhaps there is a feeling in the minds of some to the effect, "What can those 'long hairs' do for us in a practical and highly competitive business?" If there ever was any justification of such an attitude in the past, it certainly has no validity at the present time.

At the beginning of the last war the Navy, in particular, found itself up against the problem of expanding facilities for research, evaluation programs, and instruction. They turned to educational institutions with the result that elaborate research and training facilities were established. Typical of these is the installation at the University of North Carolina. Glossing over the important service rendered at the time, these facilities are still in existence and have been widely expanded through the acquisition of surface equipment and captured materiel.

Perhaps more important is the existence of a sizable group of highly competent engineers—men who have devoted their lives to the teaching profession and still find time to conduct independent research projects in line with their special talents and interests. Included in the list of current projects are some of the most troublesome problems facing our industry today.

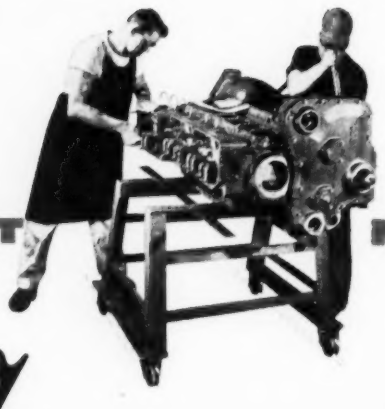
One reason for this awareness is DEMA's educational program that for the past three years has brought industry and educators closer together. This has resulted in a greater appreciation of the other fellow's problems, but there is still a long way to go.

Major emphasis has been placed on the indoctrination of the educators by industry through the medium of plant visits, talks, summer training courses, and by making available industrial text material. Now, industry should visit the college facilities to permit evaluation of the quality and scope of the work in progress and the potential service that could be rendered to them.

To some extent, industry is making use of such facilities, as evidenced by the number of cooperative projects under way, but there still is a vast pool of untapped resources. It then becomes a problem of getting industry acquainted with the available facilities. Once closer contact is established, many basic research projects could be conducted to greater advantage in colleges than in the laboratories of industry.

There are several ways that this could be worked. College professors—many specialists in certain fields—could serve as consultants. Also, staff members could undertake research projects alone, or with part-time student help. Alternatively, graduate students could work on a problem for a thesis. Industry could support these activities in three ways: establishment of fellowships at the college; by the loan of the necessary equipment; or by the initiation of financially supported research.

The benefits are many and mutual. Colleges would receive some support and direction in their objectives. Industry would not only obtain the results of the research, but would soon be getting better young engineers.



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+ HIGHLIGHTS +

● Cooper-Bessemer now has a backlog of $45,263,657.

● United States is now importing more crude oil and petroleum products than it exports.

● The New York Central RR placed in service $28,860,513 worth of new diesel equipment last year, and now has on order $97,080,000 worth of additional equipment.

● Employees of General Motors in 1950 achieved the best safety and occupational health maintenance record in the 43-year history of the organization.

● According to the Engineering Manpower Commission of the Engineers Joint Council, engineering colleges must double their enrollment to meet the nation's demand for engineers.

● There were 456,993 holders of General Motors common and preferred stock during the first quarter of 1951, the largest number in the company's history.

● Sales of Purolator Products, Inc., of Rahway, N. J., were up more than 40 per cent in the first quarter of 1951, over average monthly sales for 1950.

● According to the monthly report of the Association of American Railroads for March 1, 1951, there are 10,235 diesel-electric locomotives amounting to 14,725 units currently in service on Class I railroads.

● Construction of the world's first modern, commercial, gasoline-from-coal synthesis plant will start in South Africa within the near future, as announced today by The M. W. Kellogg Company, refinery and chemical engineers of Jersey City and New York.

● In 1951, there will be about 32,500 new graduates added to our technical reservoir.

● The Lone Star Steel Company has now started construction of a completely integrated steel mill costing $73,425,201.

● A 1840 mile 30-in. pipeline now supplies New York City with Texas gas. It is the world's longest natural gas pipeline.

● The Borg-Warner Corporation's consolidated net income for 1950, after taxes, amounted to $29,027,224, equal to $12.16 per common share.

● Westinghouse Electric Corporation has reported that new orders received in the first quarter of 1951 were the highest in the company's history and were twice as great as in the first quarter of 1950.

● Alco's backlog of defense orders totals $240,000,000 and backlog of regular products is approximately $105,000,000.

● Montreal Locomotive Works, Ltd. is now completely converted from steam locomotives to full-scale production of Canadian-built diesel-electrics.

● The average tractive effort of locomotives now being installed in service is approximately 65 per cent greater than it was 30 years ago.

● The Lehigh Valley Railroad recently ordered two self-propelled rail diesel cars from The Budd Company to replace existing equipment on the Hazelton-Lehighton (Pa.) run.

● The Standard Oil Company of California has recently placed on the market a new engine oil developed with the aid of radioactive piston rings which revealed the lubricating quality of the oil in development tests.

● Taxes in this country now take 24 cents out of every automotive dollar.

● ALCOA's new production program will increase the company's output of defense aluminum by about 50 per cent annually.

● Class I railroads in 1950 spent $1,739,908,000 for fuel, materials and supplies of all kinds used in connection with their operations.

● April 1, 1951, Class I railroads had 1883 locomotives on order consisting of 2420 power units. This included 20 steam, 4 electric and 1,359 diesel-electric locomotives.

● Orders for 11,271 new freight cars in March raised the backlog of cars on order April 1 to 158,619. 7011 new cars were delivered in March.

● The Ford Motor Company is using radioisotopes to discover hidden flaws in metal castings and as accurate thickness controls in metal rolling.

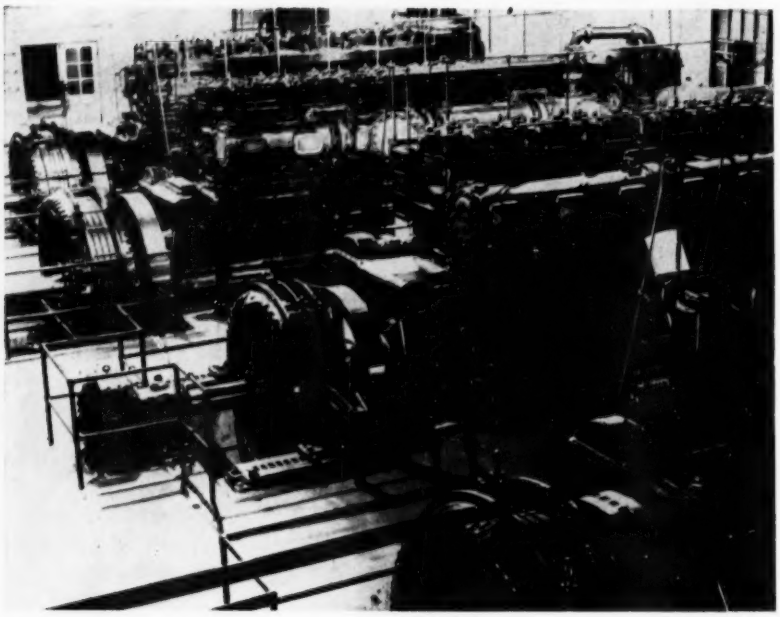
● American Brake Shoe Company orders and shipments for the first quarter of 1951 exceeded those of any previous three months' period.

● Diesel service on the 800-mile fast-freight run between Montreal and Halifax, Canada was inaugurated recently.

● One of Mexico's major steel mills, Altos Hornos de Mexico, S. A., of Monclova, Coahuila, is doubling its capacity for the production of steel strip to help supply the nation's expanding steel requirements.

● The five largest diesel-electric power vans in the world, of 1470 bhp. each, have been set to work recently on the Algerian section of the great North African "transversal" railway, extending from Tunis to Casablanca. They are intended for both passenger and freight train haulage.

Diesels in the Power Industry



Typical of long term, profitable municipal power plant operation is the Falls City, Nebraska, installation. Municipal ownership started in 1894 and in 1926 diesels started to take over. Four Fairbanks-Morse engines now provide a capacity of 3256 kw. and the plant shows a nice yearly profit.

by George W. Grupp

On December 5, 1950, Defense Mobilizer Charles E. Wilson, then president of General Electric Company, told members of the National Press Club: "We find there is indicated for 1953 a power load, or total load, of 416,000,000,000 kilowatt-hours. This is 43 per cent higher than in 1949. . . . . With the power generating equipment that has already been scheduled by the electrical manufacturing industry through the first half of 1953, and assuming that the suppliers of power are permitted to install the additional capacity they have planned for the last half of that year, the nation will have a margin of reserve generating capacity 20 per cent above the estimated load peak of 1953."

Naturally, the prime movers for some of this expansion will be diesel engines, particularly for small or medium sized power plants and where mobile generating plants are required. Other factors dictating their choice will be localized conditions such as space limitations, limited water supply and the availability of suitable fuels at low price.

Even though it is difficult to determine exactly how much of the 1950-53 power expansion will use diesel engines as prime movers, yet we do know at this writing that at least 32 private and local government and cooperative generating plants installed diesels as prime movers for their increased capacity of 38,485 kw. in 1950. This same group of plants expect to use diesel engines to expand their capacity by some 47,895 kw. in 1951; 8750 kw. in 1952; 5000 kw. in 1953; and 45,250 kw. after 1953.

Out of the grand total of internal combustion engine generating plant capacity of 1,878,280 kw. installed in public utilities throughout the United States on November 1, 1950, according to a Federal Power Commission expert, about 80 per cent of this total is produced by diesel engines.

One of the first municipalities to use diesel engines for power generating purposes is Bryan, Ohio, where in 1907 it replaced its steam engines with two 225-hp. diesel engines manufactured by the American Diesel Engine Company which later became Busch-Sulzer, now a division of Nordberg. Down through the years, since that first installation, the city of Bryan has continually used diesel engines in its electric generating plant. Today, it operates four 3600-hp. Nordberg units.

With each succeeding year, during the first twenty years of the present century, the number of diesel engines as prime movers in electric generating plants increased slowly and steadily. But since 1920, and especially since 1935, the demand for diesel engines by electric generating plants has risen rapidly.

Of course the rate of expansion of steam has been greater than that of diesels. This is chiefly due to two causes. First, most power industry experts are of the opinion that steam is preferable in large installations, whereas diesels have greater advantages in samll plants. Second, the manufacturers of steam equipment have fought hard for supremacy as indicated by the fact that the average number of pounds of coal consumed to generate one kilowatt-hour of electric current has been reduced from 3.00 lb. in 1920 to 1.22 lb. in 1950.

In this battle between the makers of prime movers, diesel manufacturers countered with many mechanical improvements and such developments as the dual-fuel system by utilizing low cost gas at high efficiency. More than

that, greater attention has been given to matching generator characteristics to those of the engine to avoid wastage of horsepower. In addition, the diesel manufacturers have advocated the installation of multiple medium sized units rather than one or two large generator sets so as to avoid the crippling effect of shutdowns due to trouble or for maintenance. This also permits improvement of the running plant capacity factor.

In some places like Bangor, Maine, the Bangor Hydro-electric Company has a 450-hp. Nordberg diesel engine for standby purposes to meet unusual peak loads, and to prevent a breakdown of service during periods of drought. Similarly, the hydro power plant at Houlton, Maine, uses three 1440-hp. Superior diesel engines.

In communities which have outgrown their old power facilities diesels have been introduced. For example, the Oxford Power & Light Company of Oxford, Wisconsin, supplemented its hydro plant with a 100-kw. Caterpillar diesel generating set. The Municipal Power Plant of Bluffton, Indiana, recently bought a 2500-kw. diesel generating set to supplement its two 100-kw. diesel sets and one 300-kw. steam plant.

The small power plant at Freeberg, Illinois, replaced its steam facilities with two 690-hp. dual-fuel Superior diesel generating sets and saves about $20,000 a year on fuel costs alone. Dual-fuel engines were installed as a supply of natural gas was expected. The fuel cost of this power plant in a comparable period amounted to $0.0192 per kw. hr. with diesel fuel oil. Natural gas was expected to reduce the cost to below $0.003 per kilowatt-hour.

Over in Newton, Illinois, a steam electric generating plant was replaced with three 800-hp. Nordberg diesel generating sets with the result that the total operating cost has been reduced from 3.5 cents to 1.0 cent per kw. hr.

During the past eight years three Caterpillar diesel generating sets in a power plant at Big Stone City, South Dakota, have produced 2,490,330 kw. hr. with the average cost per kw. hr. as follows:

Production of Electric Energy in the United States According to Prime Mover in Thousands of Kilowatt Hours

Year	Hydro	Steam	Internal Combustion	Total
1920	15,760,296	23,488,451	155,892	39,404,639
1925	21,797,874	39,367,118	286,099	61,451,091
1930	31,189,554	59,293,363	628,631	91,111,548
1935	38,372,154	56,144,412	770,824	95,287,390
1940	47,321,278	93,001,735	1,513,997	141,837,010
1945	79,970,312	140,435,268	2,080,703	222,486,283
1946	78,405,973	142,412,240	2,359,570	223,177,783
1947	78,425,492	174,500,274	2,813,218	255,738,984
1948	82,469,742	196,928,034	3,300,438	282,698,214
1949	89,748,246	197,878,185	3,473,112	291,099,543

Source: Federal Power Commission

Capacity of Public Utility Generating Plants According to Prime Movers in Kilowatts

Year	Hydro	Steam	Internal Combustion	Total
1920	3,703,531	8,919,727	90,350	12,713,608
1925	5,921,965	15,368,252	181,860	21,472,077
1930	8,585,164	23,385,522	413,677	32,384,363
1935	9,398,662	24,470,821	556,285	34,435,768
1940	11,223,729	27,774,957	928,195	39,926,881
1945	14,911,617	34,112,603	1,086,708	50,110,928
1946	14,848,491	34,312,732	1,155,398	50,316,621
1947	14,970,749	36,034,517	1,316,741	52,322,007
1948	15,651,630	39,304,033	1,604,175	56,559,838
1949	16,654,171	44,640,219	1,805,944	63,100,334

Source: Federal Power Commission

Ownership and Capacity of Public Utility Electric Generating Plants of the United States in 1949

Type of Ownership	Hydro		Steam		Intl. Combust.	
	No. of Plants	Kilowatts	No. of Plants	Kilowatts	No. of Plants	Kilowatts
Private	1,120	9,334,669	710	40,542,513	541	606,789
Municipal	173	770,110	275	2,995,736	664	961,588
Federal Projects	50	5,784,320	9	420,050	3	5,282
Cooperatives, Power Districts, & State Projects	105	718,756	33	478,896	143	219,075
Non-central stations	17	46,316	27	203,024	18	13,210
Total	1,465	16,654,171	1,054	44,640,219	1,369	1,805,944

Source: Federal Power Commission

Fuel	$0.0108378
Lubricating oil	0.0011166
Maintenance	0.0017974
Total	$0.0138018

Some electric generating plants have standby mobile units (1) to maintain service when transmission lines are being relocated or rebuilt, or while sub-station transformers are being replaced, (2) to prevent blizzards, wind storms and other conditions of nature from interrupting their service, and (3) to provide additional capacity to care for occasional abnormal loads. For these purposes the Southeastern Colorado Power Association uses one 83-kw. Caterpillar mobile generating set and another with a capacity of 100 kw.

The Northern States Power Company uses for standby purposes a 1080-hp., 960-kva., 2400/4160-volt diesel generating set mounted on a railway car which is hauled from town to town in the Dakotas, Wisconsin and Minnesota. Since its installation in December, 1946, through May, 1950, it has generated a total of 1,642,790 kw. hr.

The Wisconsin-Michigan Power Company uses for emergency purposes a 650-hp. 500-kva., 2400-volt diesel generating set mounted on a trailer. For similar purposes they also have a 250-hp., 200-kva., 2400-volt generating set, trailer mounted.

A number of the REA projects use two to eight 50-kw. mobile diesel generating sets for standby and other purposes. These portable units and stationary plants of the REA projects bring comforts, facilities and economies to farm life unheard of thirty-five years ago.

Capacity of REA Financed Generating Plants as of June 30, 1950
(operating—standby—non-operating)

State	No. of Projects	No. of Plants	Capacity in KW Diesel	Diesel Skid	Dual-Fuel	All Others	Total
Alabama	1	5	1,760	.....	.....	9,120	10,880
Alaska	2	2	1,360	125	.....	.....	1,485
Arizona	6	14	375	930	11,900	2,043	15,338
Arkansas	1	1	.....	110	.....	.....	110
Colorado	12	18	3,961	680	1,330	1,172.5	7,143.5
Florida	3	4	9,301	100	.....	300	9,701
Idaho	2	2	232	200	.....	.....	432
Illinois	4	5	3,200	25	3,480	660	7,365
Iowa	6	15	36,598	120	.....	27,500	64,218
Kansas	5	10	4,704	165	9,275	100	14,244
Maryland	1	3	3,125	....	.....	.....	3,125
Michigan	7	17	21,951	....	3,325	2,400	27,676
Minnesota	7	12	29,070	320	2,772	5,500	37,662
Mississippi	1	1	.....	120	.....	.....	120
Missouri	8	11	2,213	235	7,440	3,025	12,913
Montana	4	4	290	180	.....	2,718	3,188
Nebraska	8	13	2,441	60	.....	30,920	33,421
New Hampshire	1	2	100	....	.....	562	662
New Mexico	10	12	14,641	820	.....	.....	15,461
North Carolina	6	8	420	560	.....	1,049	2,029
North Dakota	3	5	16,330	....	.....	17,500	33,830
Ohio	2	2	.....	....	.....	150	150
Oklahoma	5	5	1,072	100	3,300	25	4,497
Oregon	4	5	150	720	.....	550	1,420
South Dakota	5	6	2,800	620	.....	100	3,520
Texas	2	2	.....	....	.....	11,600	11,600
Utah	2	4	1,332	....	.....	1,140	2,472
Vermont	1	1	492	....	.....	.....	492
Virgin Islands	1	1	682	....	.....	.....	682
Virginia	9	9	12,140	980	.....	1,079.5	14,199.5
Washington	3	3	2,650	680	.....	545	3,875
Wisconsin	3	8	9,500	....	5,400	45,500	60,400
Wyoming	4	4	400	160	400	944	1,904
Total	139	214	183,300	8,016	48,712	166,203	406,225.0

Source: REA plant tabulation of REA Power Management Section, Power Division, Department of Agriculture

Today, electricity is used on over 5,000,000 farms for home purposes such as lighting, radio, television, refrigeration, and washing; for farming purposes such as lighting barns, pumping drinking and irrigation water, heating, and power for machinery; for rural community purposes such as sanitation, school lighting, and movies; and for rural industries such as creameries, canneries, cold storage, and repair shops.

The average deep well electric pump can deliver 1000 gal. of water with a consumption of only 1.5 kw. hr. of energy. It requires only 1.5 kw. hr. of current to operate a portable milking machine per month per cow. Hay can be hoisted into barn lofts at the rate of 1/3 kw. hr. per ton.

Naturally, these and other uses of electricity on farms are not only economical, but the use of power also increases the productive capacity per farm worker, thus helping to solve the farm labor shortage problem.

Diesels are the chief prime movers of REA projects because of their advantages in small and medium sized generating plants. But with the development of larger plants, steam is reducing the margin of supremacy of diesels. In fact, many REA projects have mixed prime movers . . . that is, some use both diesel and gasoline engines, diesel and steam engines, diesels and hydro facilities, and other combinations.

Since the REA is anxious to protect its investment and assist its borrowers, the Technical Operators and Maintenance Section of the Engineering Division has its field engineers provide the operators of generating projects with the latest information on procedures of operating methods and maintenance practice as well as check on the operators to see that they carry out the suggested ideas.

Operators must make monthly reports to assure the REA Administrator that they are providing sufficient power to their project members at the lowest possible cost.

In these monthly reports the operators must record many details on each unit such as size, hour operated, gross kw. hr. produced, and fuel and lubricating oil consumed. A breakdown of costs must also be reported each month. For example, the maintenance cost of each unit must be broken down into the cost of materials and labor as well as state the number of man-hours which were required to perform the service.

Average Fuel Consumed Per Kilowatt Hour In 1949 For All Power Plants In The United States

Bituminous coal	1.22 pounds
Anthracite coal	1.63 pounds
Lignite	3.47 pounds
Gas	14.9 cubic feet
Fuel oil	0.098 gallons

Source: Federal Power Commission

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Average Production Costs per KW-Hour In Internal Combustion Plants With a 20 Per Cent Plant Factor In 1948 In Per Cent

	Plant Capacity 500-1000 KW	1001-2000 KW	Over 2000 KW
Supervision & Engineering	2.1%	2.7%	3.3%
Station labor	26.8	21.4	15.6
Fuel	39.8	49.2	57.4
Water, Supplies & Expenses	9.0	9.0	8.5
Maintenance	22.3	17.7	15.2
Total	100.0%	100.0%	100.0%
Total cost in mills per kw hr.	20.89	16.13	13.11

Source: Federal Power Commission

All of these reports are studied by the REA engineers to discern abnormal costs and performances. A critical examination of these reports enables the field engineers to be helpful to the operators by suggesting methods which will reduce their costs and increase their performance efficiency.

Report on DEMA-Washington Meeting

Pricing regulations and materials controls were the broad subjects for discussion at a DEMA-sponsored meeting at the Hotel Statler, Washington, D. C., held April 26. Representatives of the diesel industry—both engine builders and accessory manufacturers—met with government officials.

Two major benefits came out of this meeting. First, industry had the opportunity to come face-to-face with the men who are instrumental in formulating policies, and administrating them when promulgated. Secondly, they had opportunty to meet others in their field and compare interests, problems and objectives.

Mr. Robert Craig, representing DEMA in Washington, was the first speaker introduced by the chairman, Mr. Harvey Hill. He pointed out that the red tape generally associated with dealing with governmental bureaus *could* be unraveled. He stated that the meeting was designed to save the business men's time by pointing out the proper contacts.

Mr. Charles Stewart, secretary of the Machinery and Allied Products Institute, then took the floor to discuss the subjects of contract renegotiation and certificates of necessity. He highlighted the Renegotiation Act of 1951 as it differed from its predecessor, calling particular attention to the importance of initiating and keeping pertinent records up to date on subject contracts. In discussing certification for special amortization he underlined the importance of the application preparation. He offered the facilities of the Institute to point out criteria as a basis for the presentation.

The next portion of the program was devoted to a discussion of the materials problem. Perhaps one of the greatest services that can be rendered here is to list the principal agencies and personnel normally the points of contact for the diesel industry.

The diesel industry falls under the Industrial and Agricultural Equipment Bureau. Franz T. Stone, assistant administrator, heads the Bureau. Following is a list of Divisions and some of the top men:

Engine & Turbine Division
Charles F. Kells, Chief
Robert Tate, Chief, Diesel Engine Section

Motor Vehicle Division
L. S. Beerman, Chief, Automotive Branch

Railroad Equipment Division
Col. W. G. Knight, Chief, Motive Power Unit

General Components Division
Robert Cass, Acting Director
L. C. Howell, Assistant Director

Mr. Kells took the stand to say that, in cooperation with executives from industry, the entire matter of materials control was being ironed out. He admitted freely that the diesel industry on the whole had taken a beating and that the DO system "has fallen flat on its face."

Improvement was expected under the announced Controlled Materials Plan (*see Washington Slants*) and in this matter, he introduced Mr. Hardy Ray, who is currently working out some of the details. Mr. Ray characterized CMP as "born but not yet cleaned up." He stated that CMP had worked out quite well during the last war and that in view of the lessons learned, better performance could be expected of the later version.

He announced that a plan was under way for four teams—each with three NPA men and one from the military—to hit the major cities for the purpose of conducting meetings. They will explain CMP and answer questions, that arise.

Col. Knight outlined some of the difficulty facing the railroad industry and some of the corrective steps being taken. He called attention to the critical shortage of freight cars and to the fact that since dieselization that there had been a drop of about 6000 locomotives from a total during the last war of 44,000. In spite of the compensating factor of increased availability of the diesels, the claimant agency, DTA, had instructed the railroads not to scrap any more steam engines.

Mr. Tate spoke briefly on the operation of his Division and pending CMP indicated willingness to help by giving spot relief, particularly in the matter of non-extendable DO's to component and equipment builders.

Mr. Smith pinch-hit for Mr. Howell to say that the General Components Division was brand new and in process of organization.

Mr. James L. Kelly, Deputy Director, Office of Small Business, pointed out that they had been set up because early "hardship" had been anticipated. He characterized their function as being the "5 percenter for small business".

Projects include a long range program, involving a study of materials use patterns of small business to enable them to predict the effects of orders, directives, etc., and try to minimize their impact.

Walter Chamberlin, Washington representative of the NAM, was the luncheon speaker. He highlighted the WSB controversy, the President's actions as to price and wage stabilization, and commented on the international situation.

Mr. L. W. Wallace, chief, Transportation Section, Machinery Branch, Industrial Materials and Manufactured Goods Division, OPS, presided at the afternoon session. In citing the complexity of the job, he made the point that understanding should exist on both sides and that greater progress could be made if industry would make their approach without antagonism.

He mentioned the Census of Manufactures as a basis for planning. Attention was called to the OPS General Manufacturers' Regulation (effective May 28) and the Machinery Regulation to come. Reports and records were admittedly onerous, but unavoidable and must be started when the Regulations go into effect.

Texaco Combustion Process

by E. M. Barber, Blake
Reynolds and W. T. Tierney*

Multi-fuel engines, particularly when they show competitive efficiency, should have tremendous application. The facility to utilize a low cost, locally available fuel—and switch to something else should that supply fail—will show up well on the balance sheet. A cosmopolitan appetite for fuel will be a distinct advantage in view of the possibility of fuel specification downgrading in the days ahead. For the Military, the capacity to burn whatever fuel is available will greatly simplify the problems of supply in remote or forward areas.

Engines using the Texas Combustion Cycle show promise of yielding greater-than-normal horsepower and at the same time permit refiners to produce more gallons of usable fuel per barrel of crude petroleum.

AS they are now constituted reciprocating internal-combustion engines are rather selective in their fuel diet and they can use only a portion of the petroleum that potentially is available as liquid fuel. Furthermore, the efficiency with which the engines convert the heat energy of the fuel into mechanical energy is quite low.

The importance of fuel utilization on the profitable use of this power source represents a very substantial portion of the industries' research and development efforts and has been directed toward increasing the efficiency of the engines and toward simultaneous increases in the quality of the fuel and in the proportion of crude petroleum that can be made into fuel. These efforts have been relatively fruitful and over a 20 to 30-year period have resulted, on the engine side, in some 20 per cent increase of efficiency which has been obtained largely through increased compression ratio; more satisfactory spark timing; the burning of leaner mixtures and general detail refinements. In fuel processing, this time period has seen an increase of some 60 per cent in the amount of fuel produced per unit of crude oil.

The Texaco combustion process (TCP) is a method for operating the combustion phase of the cycle of a reciprocating internal-combustion engine so that knock does not occur regardless of the fuel octane number or of the compression ratio or supercharge of the engine. TCP is relatively insentitive to fuel volatility and it readily handles fuels of a broad boiling range, such as, 100 to 600° F. The features of TCP that prevent knock also allow a wide range of mixture strengths to be burned; this results in high efficiency at part load and in load control by mixture strength. To realize the benefits of the TCP, engines must be built to exploit one or more of its favorable features and this resolves itself into an exploitation of the following characteristics:

(1) Compression ratio may be increased without regard for the fuel octane number.

(2) Supercharge may be employed, in combination with high compression ratio if that is desired, without regard for the fuel octane number.

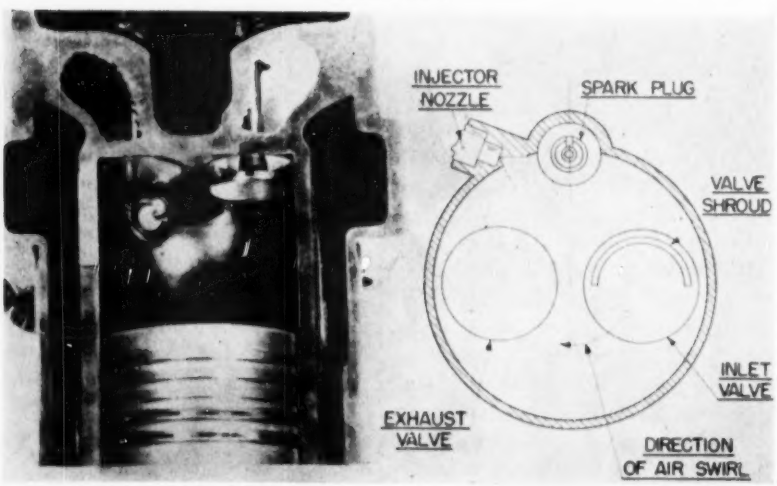
(3) Ability to burn lean mixtures will result in a favorable part load economy in almost any TCP engine application.

(4) Ability to control load by mixture strength, without air throttling, makes it attractive for 2-cycle engines which have many desirable characteristics under these conditions.

(5) A TCP engine can utilize fuels having no octane number specification and a broad boiling range. The yield of such fuel from most crude oils can be substantially greater than the combined yields of motor gasoline, aviation gasoline and diesel fuel meeting current octane number, cetane number and volatility specifications.

**Abstract of a paper presented at a meeting of the Society of Automotive Engineers. Messrs. Barber and Tierney represent the Texas Co. and Mr. Reynolds the Texaco Development Corp.*

Left—Sectioned cylinder of engine used in TCP experiments. Right—Schematic plan view of TCP engine cylinder.



Theory of the TCP

Before describing the concept and theory of the TCP we will first examine the sequence of events that leads to the occurrence of knock.

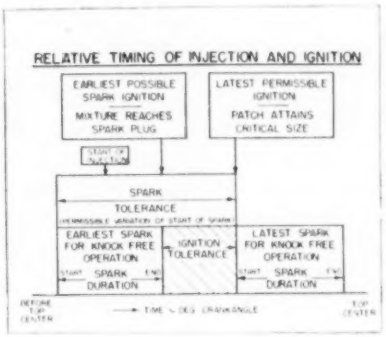
Upon ignition of the combustible mixture, a flame front is formed which burns into the combustible mixture, compressing ahead of it the unburned portion of the combustible air-fuel vapor mixture. The air-fuel vapor mixture that will be burned last is called "end gas" and will be compressed to the greatest degree. Under the resultant "end gas" temperatures and pressures, oxidation reactions occur which may lead to spontaneous ignition of the end gas. This spontaneous ignition is known as knock.

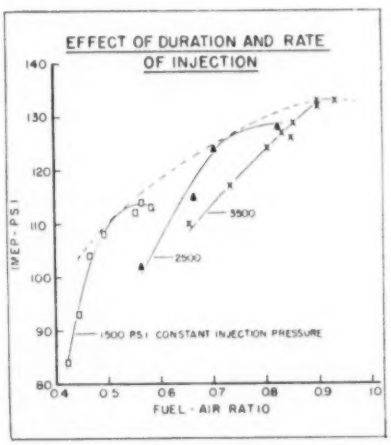
Under engine conditions of end gas pressure and temperature, knock almost invariably occurs if the end gas reactions are allowed sufficient time. However, the end gas may be consumed by the normal progress of the flame front before the end gas reactions reach this stage and, in this event, no knock will occur.

In the study of spontaneous ignition reactions, three quantities are of major importance in characterizing the reaction of any given air-fuel vapor mixture. These are the pressure and temperature and the ingition delay, the latter being the residence time of the mixture at the conditions of pressure and temperature before spontaneous ignition occurs. For a given mixture, the ignition delay time decreases rapidly as the pressure or temperature is increased.

It is customary to think of pressure and temperature as the cause, and of the residence time, prior to knock, as the effect. To better understand the TCP it is convenient to reverse this thinking and consider residence time as the cause and the pressures and temperatures that will produce knock within that residence time as the effect.

The accompanying figure is a schematic illustration of the way in which the Texaco Combustion Process is carried out to eliminate combustion knock by reducing the residence time of combustible mixture at combustion chamber temperatures and pressures. The air in the combustion chamber is caused to have a swirling motion, and fuel is introduced into the combustion chamber across the swirling air and in its downstream direction. A spark plug is located a short distance from the fuel nozzle, downstream from the nozzle.


RELATIVE TIMING OF INJECTION AND IGNITION
EARLIEST POSSIBLE SPARK IGNITION MIXTURE REACHES SPARK PLUG
LATEST PERMISSIBLE IGNITION PATCH ATTAINS CRITICAL SIZE
SPARK TOLERANCE
EARLIEST SPARK FOR KNOCK FREE OPERATION
IGNITION TOLERANCE
LATEST SPARK FOR KNOCK FREE OPERATION
SPARK DURATION
SPARK DURATION
TOP CENTER



The first element of fuel that is injected mixes with the air as it travels toward the spark plug and the resultant mixture is ignited substantially as soon as it reaches it. The remainder of the fuel is injected continuously into the swirling air and during this continuing injection a flame front is established; fresh combustible mixture is formed continuously and fed into the flame front and combustion products are carried away from the flame front.

In addition, TCP makes it possible to burn very lean overall air-fuel mixtures by terminating the injection before all of the swirling air has been mixed with fuel. It follows that high part load efficiencies can be obtained and that the engine power can be controlled by variation of fuel quantity without air throttling.

Physical Apparatus and Typical Characteristics

Experimental apparatus used for one of the early trials of the TCP is illustrated by the photograph of a sectioned cylinder and by the plan view of the cylinder. The cylinder shown is of the 4-cycle poppet valve type; air swirl is induced by the shrouded valve and the spark plug is located approximately 30° of arc downstream in the air swirl from the injector position. The bore and stroke of the test engines ranged from 3¼ by 4½ in. to 6 by 6 in.

The engine was tested on the following fuels: iso pentane, alcohol, benzene, kerosene, diesel fuel, tractor fuel, triptane, iso octane, N-heptane, cetane, alpha-methyl-naphthalene, and others. As the engine was changed from fuel to fuel there was no noticeable or measureable difference except the slight power changes attributable to changes in the heating value of the fuels.

The flexibility of the engine was tested under a wide variety of operating conditions. The range of knock-free operation was determined as follows:

Compression Ratio ..... 6 to 12
Manifold Pres., in. Hg.abs. 10 to 120
Jacket Temp, °F ..... 212 to 375
Intake Air Temp, °F .... 90 to 400
Speed, rpm. ..... 200 to 4400
Load ..... *Idle to full, any rpm.*
IMEP, psi. ..... 20 to 400

In a TCP engine, if the injection of fuel is terminated before a complete air swirl has occurred, only a portion of "patch", of the air will have been impregnated with fuel vapor. The fuel-air ratio of the patch will depend on the mass rate of air swirl and on the mass rate of fuel injection. The patch fuel-air ratio will be greater than the overall ratio of fuel and air consumed by the engine; thus the patch is made to have a spark ignitible mixture strength even

though the overall mixture is leaner than would be ignitible. The mixture ratio control of load depends on this patch burning.

Elements Controlling the Elimination of Combustion Knock

As has been stated earlier, the elimination of combustion knock is obtained in the TCP by limiting the residence time combustible mixture at combustion chamber pressures and temperatures. Following are the major considerations that require coordination.

Relative Injector and Spark Plug Location—As the distance between the injector and spark plug is increased a larger patch of mixture is built up before ignition can take place, until finally the patch becomes so large that in some remote portion of it the permissible residence time is exceeded and knock occurs. Experiments have demonstrated that knock-free operation may be obtained with the spark plug located between 30° and 60° downstream of the injector.

Direction and Character of Fuel Spray—The spray must be strong enough that it is not deflected excessively by the swirling air and at the same time is not so penetrating as to pass beyond the plug before ignition.

Relative Injection and Ignition Timing—For knock-free operation a spark must exist at some time during the period designated as "ignition tolerance". If the spark has died out before this period commences, the engine will either misfire or fire by compression ignition depending upon the quality of the fuel. If the spark does not start until after this period has passed, the patch of combustible mixture will be so large, and accordingly the residence time so long, that the occurrence of knock will be dependent upon the octane value of the fuel. Therefore, it is necessary that the start of the spark be somewhere within the period designated as "spark tolerance".

Spark timing is, however, dependent upon injection timing and may not be considered an independent variable. The spark tolerance is so liberal, however, that a fixed timing is often satisfactory over the entire speed-load range of the engine. Spark timing within its tolerance has a negligible effect on power output.

Elements Controlling Efficiency

Elements of the TCP that eliminate combustion knock do not automatically lead to good efficiency. Following are some other conditions that must be satisfied as well. Efficiency as used here is not only the efficiency with which the engine uses its air and fuel, but also that with which its displaced volume is utilized.

Breathing Capacity—The chief method of inducing air swirl has been through a suitably designed intake port equipped with a shrouded intake valve. This method, although subject to severe loss in volumetric efficiency if inadequate care is taken in the design, has been refined to the point where good volumetric efficiency is compatible with production of the required air swirl.

A well-designed induction system will produce suitable swirl for TCP without loss in volumetric efficiency up to mean piston speeds of 2000 to 2500 ft./min. for naturally-aspirated engines and higher for supercharged engines.

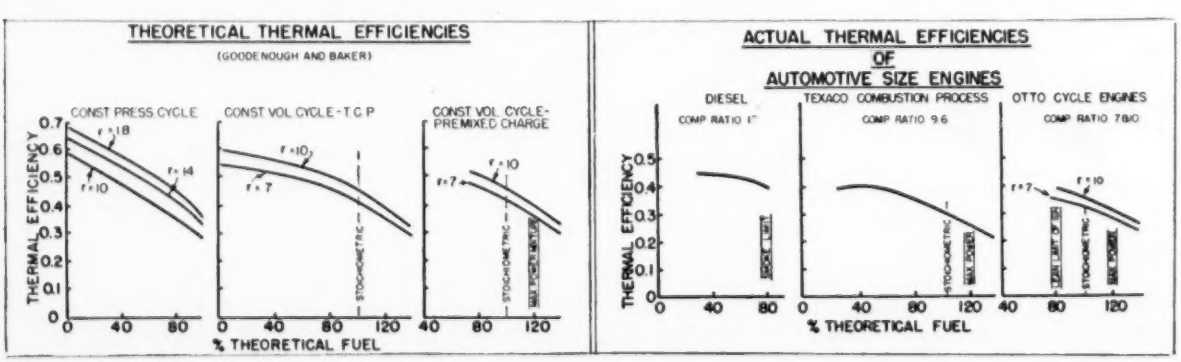
Breathing capacity of a TCP engine may even be increased over that of a carbureted engine, as manifold density is generally higher for the TCP engine because it requires no carburetor pressure drop for metering purposes and no external addition of heat for vaporization.

Utilization of Air and Fuel—The efficiency with which the air and fuel are utilized is dependent chiefly upon the coordination of fuel injection with air swirl. To meet these conditions the air must swirl at a suitable rate and the fuel must be distributed properly both in time and in space.

(1) Spatial Distribution of Fuel—The spray pattern and position of the spray in the cylinder play an important part in attaining maximum air utilization for full load operation. An acceptable spray arrangement will tolerate a change in direction about the point of injection with only minor change in engine output. However, an unsuitable spray arrangement may cause an appreciable loss in efficiency even though it results in knock-free engine operation.

(2) Temporal Distribution of Fuel—Temporal distribution may be characterized by the timing, rate and duration of injection. Injection timing determines the time in the engine cycle during which the charge is burned and the effect is similar to ignition timing in a conventional spark ignition engine.

Rate of injection, in conjunction with rate of air swirl, controls the fuel-air ratio of the successive increments of mixture formed and thereby, the efficiency of combustion.



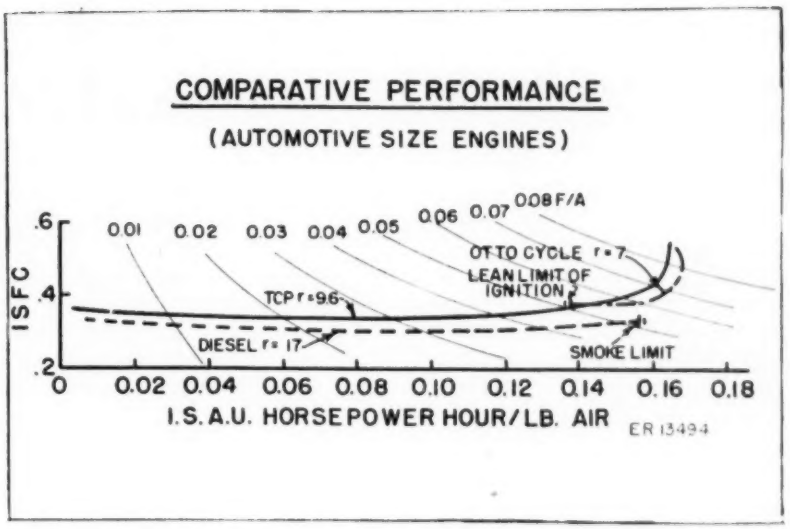
With the injection rate fixed by the injection system, injection duration then controls the output of the engine by controlling the total amount of fuel which enters each cycle.

To determine the required rates and durations of injection a special pump was developed with which the beginning, rate and duration of injection can be adjusted independently. Application of this pump produces results similar to those shown in the accompanying figure, where each hook-shaped curve corresponds to a given average rate of injection, and the successive points along the "hook" correspond to increasing durations of injection. The envelope of the curves represents the best duration of injection for the particular engine under test. When the durations and average rates of injection, corresponding to the envelope curve of the figure, are duplicated in a conventional jerk-pump injection system, engine performance with the jerk-pump system falls directly on the envelope curve of the figure.

(3) Air Swirl Rate—The swirl rate itself basically determines the duration of combustion for a given load and thereby, affects the efficiency of air and fuel utilization.

Normal full-load combustion duration for TCP is about 60° of crank-angle for a swirl rate of six to seven times the crankshaft rpm. and it varies inversely as the rate of swirl.

When the various elements controlling efficiency and elimination of knock are properly integrated, TCP operation is fully flexible over the entire speed-load range of the engine on any petroleum fuel capable of being pumped through the injection system and without the need of any adjustment other than positioning of the pump rack for load control. Since it operates in this manner, it must be considered a practical and potentially useful operation and its efficiency becomes of interest.



Comparative Efficiency

It is convenient to examine the efficiency of the Texaco Combustion Process by comparison with the efficiencies of the other two cycles, otto and diesel, with which it will have to compete.

Theoretical & Actual Thermal Efficiency—First, consideration will be given to the theoretical thermal efficiencies of the three types of combustion, as shown in the accompanying figure. The curves are all based on the analysis of Goodenough and Baker* for the fuel-air cycle with theoretical shape of indicator card and no heat loss.

The theoretical TCP cycle, is identical with the Constant Volume Cycle Premixed Charge (otto cycle) from 120 to 30 per cent theoretical fuel. It is, however, extended into the region of very lean mixtures by the ability to "patch burn". Present thoughts are that a TCP engine would be used in the range of 10 compression ratio, (otto cycle—5.5 to 7.5), as a compromise between high efficiency and excessively heavy engine construction. The diesel operates on the constant pressure cycle with compression ratios averaging 16 to 1.

Actual thermal efficiencies for diesel, otto and TCP engines are shown in the accompanying figure, on a basis comparable to that used for the theoretical efficiencies.

In diesel engines, because of smoking, the mixture strength seldom exceeds 80 per cent of theoretical fuel, that is 80 per cent of the fuel for complete combustion.

The otto cycle engines operate in the range from 80 per cent of theoretical fuel, the lean limit of spark ignition, to 120 per cent of theoretical fuel, maximum power. Light load operation is achieved at the expense of air throttling and its attendant pumping losses.

The TCP engine covers the full mixture strength range up to maximum power at 120 per cent of theoretical fuel. It does not exhibit either the smoke limit of the diesel or the ignition limit of the otto cycle engines.

Comparative Indicated Performance—Further light is shed on the relative performance of the three engines by a comparison of their utilization of fuel and air. The accompanying figure of Indicated Specific Fuel Consumption (ISFC), expressed as pounds of fuel per indicated horsepower-hour, versus Indicated Specific Air Utilization (ISAU), expressed as indicated horsepower-hours per pound of air, is particularly suitable for this comparison. The ISAU is proportional to indicated horsepower once the air consumption of the engine is known. This plot uniquely defines the performance of an engine, since both variables are determined by the mixture strength and the corresponding value of thermal efficiency.

Superimposed on this plot are thermal efficiency curves for the three

(*Continued on Page 67*)

**A Thermodynamic Analysis of Internal Combustion Engine Cycles, Engineering Experimental Station, University of Illinois, Bulletin 160.*

Air Force Development of a Light-weight Multi-Fuel Diesel Engine

*by M. E. Davis and Dr. F. J. Neugebauer**

Original thinking and three years of research has resulted in the development of a multi-fuel diesel engine with impressive characteristics. This is another step toward broadening the application of the diesel cycle.

FOR the past three years, the U. S. Air Force has been pursuing the development of a simple 2-cycle, lightweight air-cooled diesel engine, capable of operating on fuels ranging from common diesel oil through 100-octane aviation gasoline. This development is not aimed directly at the production of a new engine per se, but is part of a larger program to develop a compact, lightweight air compressor for general aircraft maintenance and servicing. The multi-fuel operation represents only a small detail in the course of the over-all development.

The Air Force in 1947 embarked upon the development of a lightweight, high-performance air compressor to produce up to 20 cfm. at a maximum pressure of 4000 psi., with provisions for operating at any intermediate pressure down to 350 psi. In the study phase of this project, three factors were considered:

(1) To produce a single machine, which would be simple from an operational and maintenance viewpoint; and to cover compressed air delivery and pressure ranges which heretofore have been covered by a number of different machines.

(2) In the interest of air transportability in combat-type aircraft, to hold weight and size to a minimum.

(3) To achieve uniform reliability of operation and performance, regardless of ambient climatic environment.

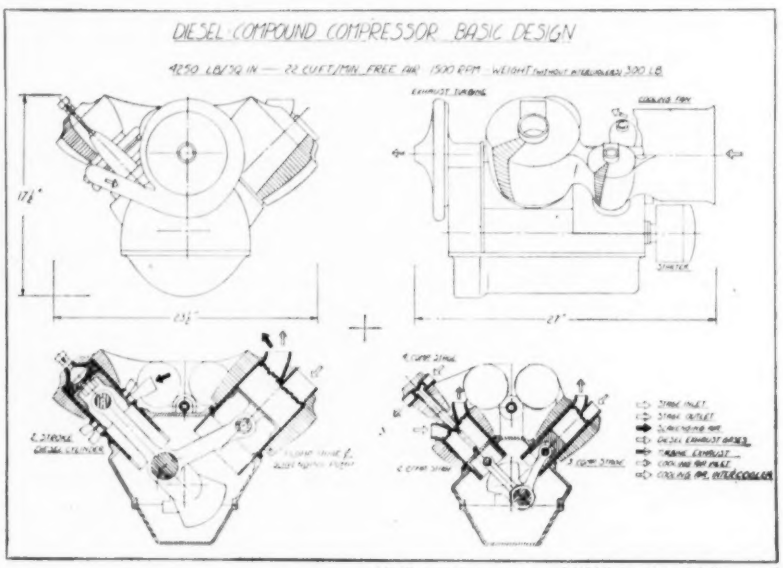
The possibility of developing a self-contained machine driven by a multi-fuel engine was also taken into consideration. The following types of engines were considered:

(a) *Lightweight Compressor Driven by a Conventional Spark Ignition Engine* —With these engines a certain amount of exhaust gas remains in the cylinder at the end of each working cycle. This exhaust gas serves a dual purpose; it helps to evaporate and chemically prepare the heavy fuels for spark ignition, and it decreases the knocking tendency of low-octane fuels. This system, however, has two characteristics which were considered detrimental: (1) the power-displacement ratio decreases due to the incomplete removal of the exhaust gas; and (2) gasoline was needed to start the engine before operation on heavier fuels.

(b) *Evaluation of Other Multifuel Configurations* — The Texaco engine would meet the requirement of multi-fuel operation. However, the main disadvantage to this type of engine is its need for both an ignition and an injection system; the use of valves and concomitant mechanisms; a cylinder head which is not especially adapted for air cooling; and resulting fabrication and maintenance problems.

(c) *Free-Piston Diesel Compressor*—A machine of this type appeared to offer an attractive solution. However, upon examination several discrepancies were revealed which were considered detrimental:

(1) The Air Force is interested in aircooled equipment because of its lighter construction weight and its better suitability for arctic operation. The free-piston configuration does not lend itself to efficient air cooling. This is especially true for the final compressor stages of relatively small diameter, which must be arranged inside the first or intermediate stages to avoid excessive construction length. Further-



All illustrations courtesy of USAF Air Materiel Command

Basic design of en-bloc engine compressor combination developed in the Air Materiel Command Equipment Laboratory.

Engineering Division, Directorate of Research and Development, Air Materiel Command. Abstracted from the "Technical Data Digest", published by the Central Air Documents Office, by permission of its Editor, G. H. Rogge, Jr.

more, the synchronizing gear interferes with the cooling fins of the diesel cylinder.

(2) Up to the present time, the only widely accepted method of starting free-piston engines is by the use of compressed air. In emergencies, starts cannot be made if compressed air is not available.

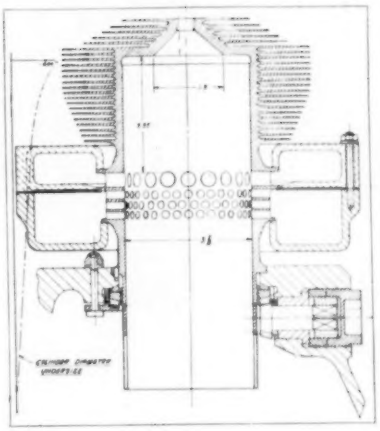
(3) The operation and maintenance of a free-piston compressor requires special skill and experience.

(4) In the early developmental phases, it was anticipated that a free-piston compressor would require fewer parts. It was later proved, however, that the crankshaft configuration would weigh less than the free-piston configuration.

(5) If a wide range of discharge pressure is required without objectionable waste of fuel, the governing system of a free-piston compressor offers considerable difficulties. The equilibrium of the free-piston compressor must be maintained and the pressure ratio cannot be appreciably altered without disturbing the balance of the forces throughout the system. Therefore, it is common practice to maintain compressor operation against a constant maximum head and reduce the pressure of the air through a reducing valve.

(d) *Lightweight Compressor Constructed En-Bloc with a Supercharged, Air-Cooled, Multi-Fuel Two-Cycle Diesel Engine*—It is generally known that a diesel engine, of the size required to drive the compressor in question, can be successfully air cooled when the construction methods usually associated with high-output aircraft engines are incorporated in the design. Two-cycle engines are especially adapted for air cooling because of their simple valveless cylinder-head construction. Technical reports published in this country and abroad describe in detail how any diesel engine may be adapted for fuels of different knocking qualities by gradual injection and by the use of so-called cetane selectors.

The method under discussion involves a two-step controlled injection whereby a small portion of the fuel is initially admitted at a low rate until ignition takes place, after which the remainder of the fuel charge is forced

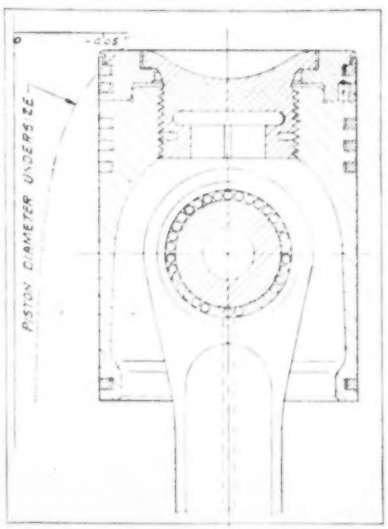


Cylinder configuration used as a starting point for development.

at a high rate into the flaming mixture. Knocking is eliminated in this manner by preventing the spontaneous combustion of large amounts of fuel. An injection pump incorporating a suction valve is especially recommended for this application because such a pump starts delivering fuel gradually from its lower dead center.

For high-octane fuels, a German report suggests the addition of a small amount of lubricating oil to the fuel, thus lowering the octane number. A diagram taken from this report shows the specific Btu. consumption, and the ratio of peak pressure to compression pressure determined by actual tests are plotted against the injection timing.

Promising piston design based on experience with Junkers aircraft diesel.



It is apparent that the corresponding curves for high-cetane and low-cetane fuels are practically parallel. From these indications it follows that the same combustion effects can be obtained by merely adjusting the injection timing when changing from one fuel to another.

As a result of the above evaluation, a design study of an en-bloc engine-compressor combination was made in the AMC Equipment Laboratory. This design-study, illustrated by the accompanying figure, offered the more practical solution from an engineering viewpoint and was finally selected as a basis for the development.

A special feature of the design is the oversized first compressor stage which delivers not only compressed air to the second compressor stage, but also the scavenging and supercharging air for the diesel cylinder. The energy contained in the pressure exhaust of the supercharged engine is not wasted, but is utilized to generate the cooling air flow for the engine, compressor, and intercoolers.

The accompanying illustration depicts an exhaust-driven turbine blower for this purpose. However, pressure and gas-flow measurements taken during tests indicate that it might be possible to simplify the cooling arrangement by using an exhaust-operated air-ejector for the purpose.

A few of the preliminary design studies made by Air Force engineers prior to awarding the final contract are illustrated. Several important innovations and features which subsequently proved successful included the utilization of the entire cylinder circumference for inlet and exhaust ports, the central symmetrical arrangement of the combustion chamber, and the simple design for cylinder head cooling.

The piston design which proved noteworthy is based on past experience with the pistons of the Junkers aircraft diesel engine. The figure shows a piston crown of heat-resistant steel with a portion of the upper piston rings incorporated in this crown. Furthermore, it shows an air gap between the crown and the piston body by which the rate of heat flow from crown to body can be controlled to

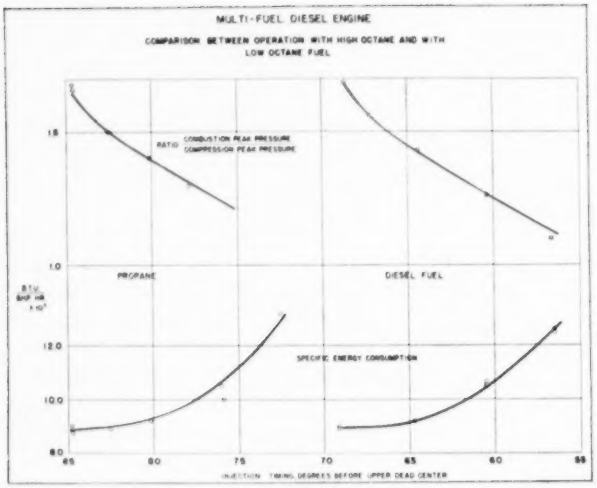
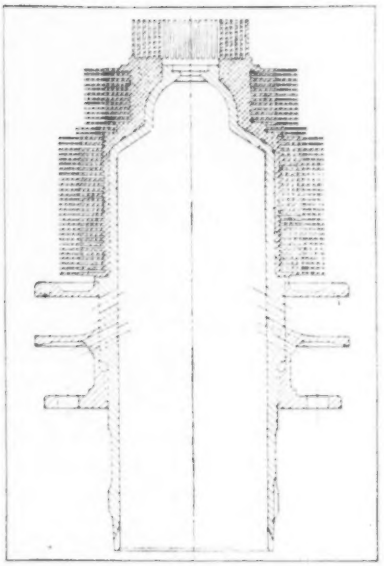


Diagram taken from German report on multi-fuel engine.



Section through cylinder in its present state of development.

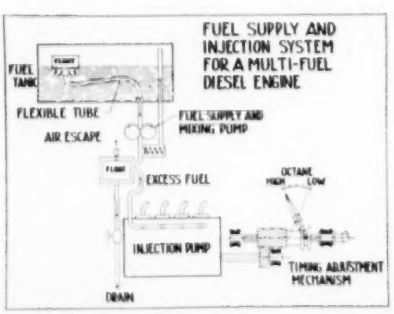
obtain a favorable temperature distribution in the ring zone. Thus, the upper rings can be maintained above and the lower rings below the temperature zone in which lubricant coking occurs. The top ring is designed in such a manner that it is forced against the cylinder wall by the gas pressure. The foresight in this special type of ring design proved to be important in later tests. Finally, the design incorporates a comparatively flat piston crown which generally produces higher bmep. and lower specific fuel consumption.

It was recognized at inception that the proposed engine configuration could not be successfully dimensioned without careful preliminary research work. Consequently, Equipment Laboratory engineers suggested a water-flow test stand consisting of a transparent plastic cylinder with identical dimensions as the test engine to study the scavenging action. The velocity of the water was to be maintained at the approximate Reynolds numbers which were expected in the engine. This apparatus could be used to determine the shape of the scavenging swirl and the time required for scavenging by photographing the expulsion of dyed water representing combustion products, and by clear water representing scavenging air. Later developments proved the indispensability of this test stand.

In June 1948 a development contract was awarded Barnes & Reinecke, Inc., of Chicago. All preliminary computations, design criteria, sketches, etc., produced by the Air Force were submitted to this corporation. The program was established from the data supplied by the Air Force.

The water flow test stand was adopted and improved by the contractor. This test stand produced the data for size, shape, direction of the inlet and exhaust ports, as well as information for possible shapes of combustion chambers and piston crowns. A single-cylinder engine was constructed substantially in accordance with the results gained from the water flow tests. The dimensions of the test engine are 3⅝-in. bore, 4⅝-in. stroke, 47.5-cu. in. piston displacement.

In the comparatively short time of approximately 18 months, tests with the single-cylinder engine were completed to the point where the engine performance was sufficient to meet the power requirements of the compressor. The single cylinder tests were conducted on a CUE test base at the Armour Research Foundation in Chicago. Since the compressor was to be operated at 1500 rpm., the test runs were performed for the most part at this speed.



The air cooling proved very reliable from the beginning, and the piston operated practically trouble-free through 1000 hr. of operation. The tests included supercharging at pressures up to 25 psia. and multi-fuel operation with all the unusual strains which normally occur in such test operations. Measurements indicate that the power required for cooling is well below the demand of conventional engines of similar size.

Special advancements were made in the design of the combustion chamber and the fuel injection system with regard to multi-fuel operation. In the final stages of development, the engine operated smoothly with diesel fuel, jet fuel, kerosene, and 100-octane aviation gasoline. Only the injection timing required adjustment according to the cetane number of the fuel. The adjustment was made during engine operation by means of the sliding helical gear used to time the point of injection. Illustrated is the sliding helical gear arrangement, as conceived by Air Force Engineers.

The performance of the engine does not vary to any significant extent from fuel to fuel and the engine is capable of starting and operating on any type fuel within the ranges previously outlined.

The bmep. and specific fuel consumption of the test engine was improved step by step until the values

which are characteristic for conventional 2-cycle diesel engines of this size were reached and the engine had met the power demand of the compressor.

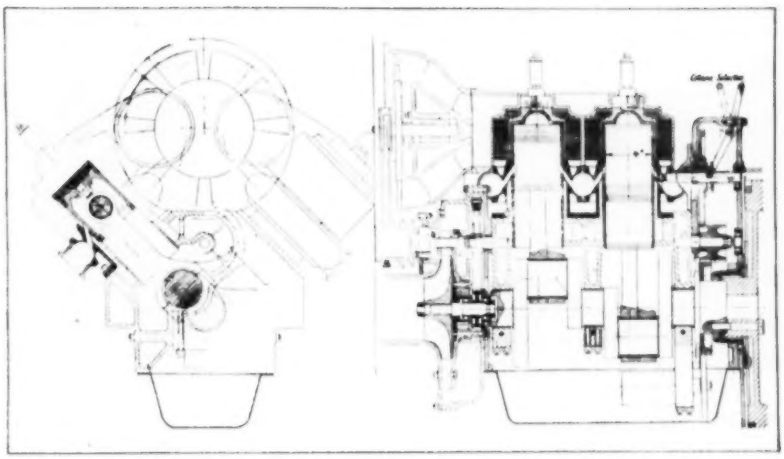
A cross section through the cylinder liner in the present state of development is shown. The simplicity of design and freedom from valves and actuating mechanisms are clearly illustrated by this sketch. The results of the tests conducted at 1500 rpm. appeared so promising with respect to future development that a few additional runs were made to study the behavior of the engine at speeds up to 2400 rpm. With 22-in. Hg gage supercharging pressure, 80° F inlet temperature, and a scavenging factor of 1.9, a maximum bmep. of 160 psi. was noted in the vicinity of 2500 rpm. Theory and test results indicate that the design principles of the engine would prove especially valuable in short stroke arrangements.

Estimates based on the data compiled to date indicate that under ideal conditions a weight-power ratio of 2.2 lb. per hp. may be reached at 3000 rpm. and 22-in. Hg. gage supercharging pressure. A weight-power ratio of 1.5 lb. at 3000 rpm. and 36-in. Hg gage supercharging pressure is considered feasible. A power output of 0.9 bhp. per cu. in. displacement is considered to be attainable.

These values may be somewhat optimistic: however, there is no doubt that sturdy multi-cylinder engines based on this principle can be fabricated with a lower specific weight than any known diesel engine prime mover.

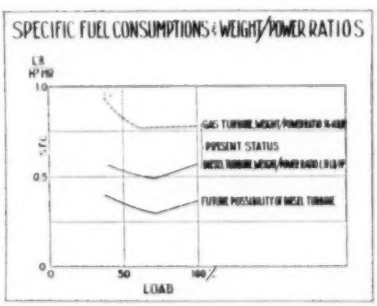
A recent Air Force conception of an unsupercharged four-cylinder diesel prime mover for general application which might attain a still-lower specific weight is shown. The sketch illustrates the sturdiness and simplicity of the configuration, not only with respect to the cylinder construction, but also with regard to the small number of gears.

From the beginning, the potentialities of this type engine were recognized relative to its use as an energy producer for the operation of gas turbines of high fuel economy. However, the restricted aim of the present project precluded any detailed work along these lines. With the data already compiled, there is no doubt that substantial reductions in the consumption of fuel and air are possible. Even in its present incomplete status, the engine presents remarkable possibilities for future applications in this field of power generation.



Air Force conception of an unsupercharged, 4-cyl., 2-cycle, aircooled multi-fuel diesel engine. Rating of 150 hp. at 3000 rpm. with 132 cu. in. displacement is thought possible.

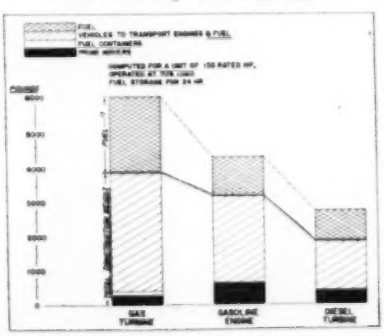
An investigation in which a plain bleed-and-burn-type gas turbine with heat exchanger is compared with a diesel-turbine indicates that the latter offers several outstanding advantages in many applications. The results obtained by this comparison are roughly outlined in the figure which shows specific fuel consumptions and weight-power ratios for the two types of prime movers. The lower solid line indicates the efficiency considered possible with future refinement of the diesel-turbine. It might be mentioned at this time that the diesel-turbine will exhibit the same advantageous torque characteristic as any other turbine.



Fuel characteristics and weight-power ratios for two prime mover types.

A comparison is given in the bar graph of the weights involved in ground operation of a gas turbine, a gasoline engine, and a diesel-turbine. The construction weight of the vehicles which will be needed for fuel transportation is taken into consideration. It can be easily seen that in many cases the over-all construction weight of the diesel-turbine plus support equipment is much less due to its lower specific fuel consumption. This weight differential will become progressively more noticeable in proportion to the operating time indicated by the figure.

Prime mover comparisons based on computations involving specific criteria.



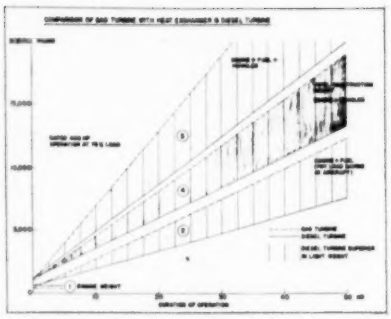
Area (1) represents the construction weights of the bare engines.

Area (2) represents the sums of construction weights plus fuel weights. This comparison indicates the savings in payload if a diesel-turbine is used for auxiliary power in an aircraft instead of a gas turbine. The abscissa of

the plot represents, in this case, the duration of operation during one flight.

Area (3) is the comparison of the sums of construction weights of engines, fuel weights, and weights of fuel-transportation vehicles if the units are used in ground operation. The abscissa is, in this case, the duration of operating time during which the combat unit must rely upon the fuel transported by its own fuel tanks.

Area (4) is a comparison of the sums of construction weights of engines plus transportation vehicles without fuel weights. This area is a comparison of the over-all construction weight involved which is critical from a logistical and supply viewpoint under actual combat conditions when every extra pound required for fuel, transportation tanks, etc. means proportionally less food, ammunition, medical, and other supplies. It further illustrates the direct and indirect drain on resources and man power, specifically in refineries, fuel-handling equipment, truck manufacturing, etc.



Weight comparison of prime mover types. See text for explanation.

It is considered worthwhile to continue the studies on this type of engine for the following reasons:

1. The engine covers a broad field of applications from simple prime movers to economical diesel-turbines, which is desirable from the viewpoint of standardization and supply.

2. The engine is of simple construction which promises high reliability and savings in man power for manufacturing and maintenance.

3. The weight of the engine is low and the utilization of the displacement is high, which decreases the stress on material resources and facilitates air and ground transportation.

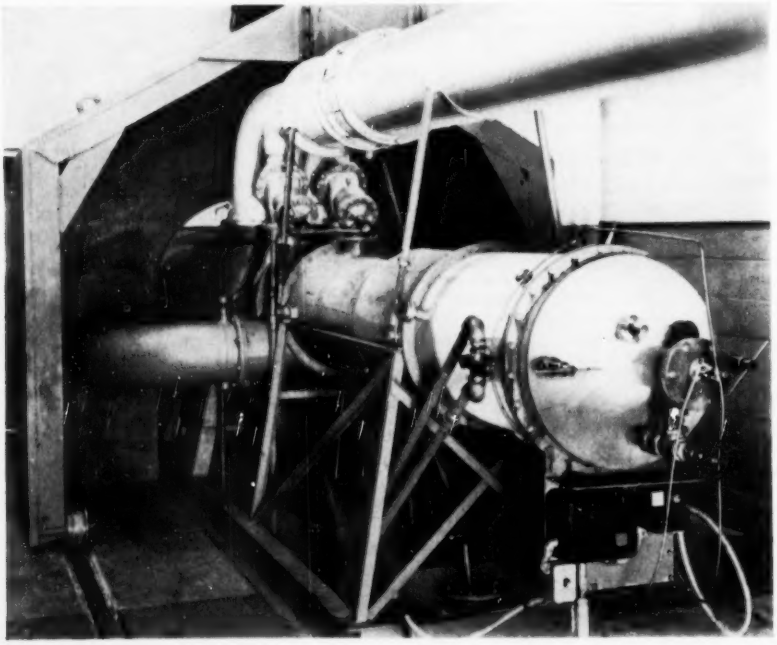
4. The engine operates with every kind of liquid fuel used in the Armed Forces, which is important from a logistical viewpoint.

5. The engine is very suitable for air cooling, which is desirable in arctic operation.

This development closes an important cycle in that it joins the diesel engine with the gas turbine and the spark-ignition engine in lightweight construction and in independence from the type of fuel. In addition, remarkable possibilities have been disclosed for future major advancements in military prime movers. It is believed that the door has been opened to a vast new field of development in which the diesel cycle can be exploited.

Equipment for Pre-Testing Turbochargers

A new development only recently put into operation at the Cooper-Bessemer Corporation's Mt. Vernon plant, now makes possible complete performance tests of each exhaust-driven supercharger prior to installation on its engine. Heretofore, manufacturer's tests on such superchargers have been limited primarily to running the superchargers at top speed using steam. Now, however, by means of an apparatus specially designed by this engine builder, each supercharger is performance run under conditions of loads and temperatures well in excess of those on the engine for which it has been built.



More commonly referred to as a "boot strap" tester, the new rig makes provision for each supercharger to propel itself. In operation, air discharged from the supercharger's centrifugal compressor is directed through an oil fired combustion chamber. The heated air is then piped through the supercharger's gas turbine, driving in turn the same centrifugal compressor unit before being discharged into the atmosphere. Variations of load are determined by the amount of air discharged from the centrifugal compressor. Temperature is governed by the rate of combustion in the heating chamber. Thus any practical combination of operating temperature and load known to exist on a gas, diesel or dual-fuel engine can be quickly duplicated at little expense on the test floor.

Washington Slant

CONTROLLED MATERIALS PLAN (CMP) is on its way. Will go into effect on July 1, 1951 and is expected to correct many of the deficiencies of the present DO system. Details may be available before this appears.

OPERATION IS PARALLEL TO WORLD WAR II CMP except in few details that are believed to improve it. Major differences are "open end" feature and immediate decentralization. Same common denominators—steel, copper, aluminum—are used.

PRODUCTS PROGRAMMED under CMP will fall in "A" and "B" categories. No priority is implied by designations. "A" product is one where most convenient method of production authorization is vertical; authorization and material allotments direct from Government Agency to builder for particular and special items. "B" list will consist of so-called "shelf-items" and authorization and allocation will be horizontal. List includes civilian-type products, industrial machinery, etc., needed for defense or defense-related production.

LIST OF "B" PRODUCTS is similar to old CMP list. Some items will bear asterisks, indicating that they are not programmed. All others are. Starred items will probably be first cut out in all-out emergency.

CMP 4-B FORM requesting materials is filled out by industry. NPA processes all applications with basic thought not to cut but to expand production. Materials for "starred" items on "B" list must be obtained in free market; forms are not submitted. Material requirements for all programmed items are then known and can be balanced against known supplies.

CMP IS A QUANTITATIVE PLAN and "certified checks" for specific types and quantities of materials will be issued on known stocks in contrast to the DO "hunting license". Present feeling is that after balancing programmed demand against supply that there will be a surplus.

OPEN END FEATURE OF PLAN follows late World War II developments and surplus goes out "open end" to free market. Office of Small Business is advocating earmarking part of surplus to give non-programmed manufacturers 50 per cent of base requirements, balance to come from free market.

DECENTRALIZATION IS PLANNED and authorizations and allocations will be handled through field offices wherever possible. This cuts down paper work in Washington and saves the producers time, trouble and expense.

M ORDERS AND DO RATINGS will stay in existence. Purpose, to control free market for materials. Third quarter of 1951 will be rugged during transition, since DO's are not extendable under CMP. Eventually, new DO numbers with an accompanying CPM symbol will take over.

NEW GENERAL COMPONENTS DIVISION will help accessory men to get materials. Most of these products will be programmed and on "B" list. Materials will be allocated directly on basis of 4-B form. In this case, Form goes to NPA; "A" list suppliers turn to purchaser (usually government agency) who applies for authorization and allocation of materials.

FIRM ALLOCATIONS EXPECTED TO START IN JULY and in the meantime May and June will be hit or miss. On defense and defense-related production NPA will do its best to give spot relief. Manufacturers must make their needs known to the right people (see DEMA-Washington Meeting Report, this issue).

MANUFACTURERS HAVE RESPONSIBILITY to try all available sources of material to get on delivery schedule before applying to NPA. Not a question of usual or favored supplier, but of every possible source. If no luck, then NPA will try to help.

WAREHOUSES ARE EMPTY in many cases and small purchasers, say of steel, cannot get on steel company delivery schedule. CMP recognizes the situation and is expected to provide relief by insuring flow to warehouses.

IN THE MEANTIME operation under the present system will continue. Attention is called to previous comments on Reg. 4 covering MRO (maintenance, repair and operating materials) with its accompanying DO-97 rating.

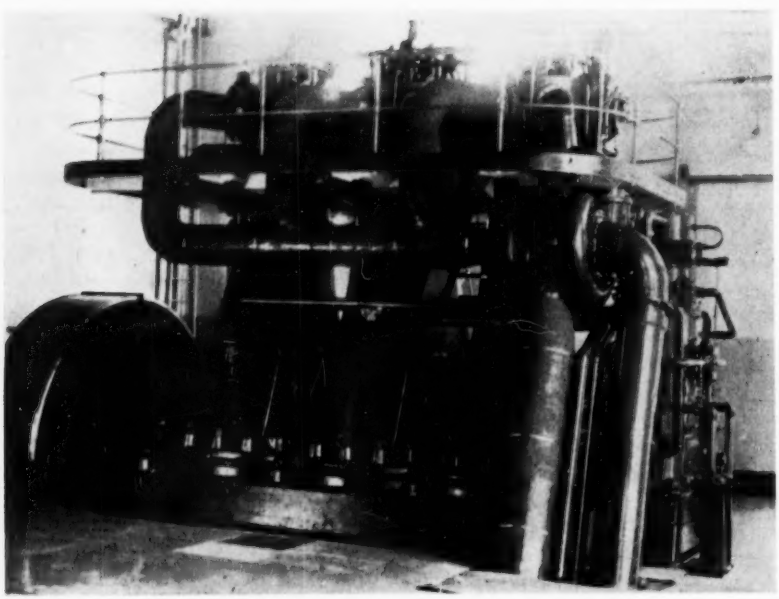
QUARTERLY MRO REPORTS ARE NOT NECESSARY where started before 1950. Only firms, agencies, etc., starting operation in 1950 need report.

NEW ORDER M-50 APPLIES TO PUBLIC ELECTRIC UTILITIES and provides for procurement and use of MRO materials, superseding *only* conflicting provisions of Reg. 4. It also provides for program materials for major plant additions approved by DEPA (Defense Electric Power Administration). DO-48 or DO-48 (minor) rating can be extended. "Minor" requirements include program materials (MRO, too) not classified as "major plant addition". The latter involves line or non-line construction with a net material cost of over $50,000.

Good operational record leads to

A Pipeline Diesel Expansion Program

by W. H. Gottlieb



One of the company's four 25-year old Fulton diesels. Two of these units at East Fort Madison have a combined service record of more than 300,000 engine hours.

IN a two year expansion program which raised oil-handling capacity to unprecedented heights, the Service Pipe Line Company has added 14 new diesel and dual-fuel engines totalling 22,650 hp. to some of its active pumping stations. Further expansion at other stations (by supercharging oil diesels and installation of new electric pumping units) has brought total active horsepower to a new high.

Of equal interest to everyone who operates internal combustion engines has been Service's success in keeping old diesels at work over a long period of years utilizing as fuel whatever crude oils are available. A notable example is a pair of 25-year old Fulton diesels with a combined service record of more than 300,000 engine hours. We'll go into this record a little more thoroughly in a moment.

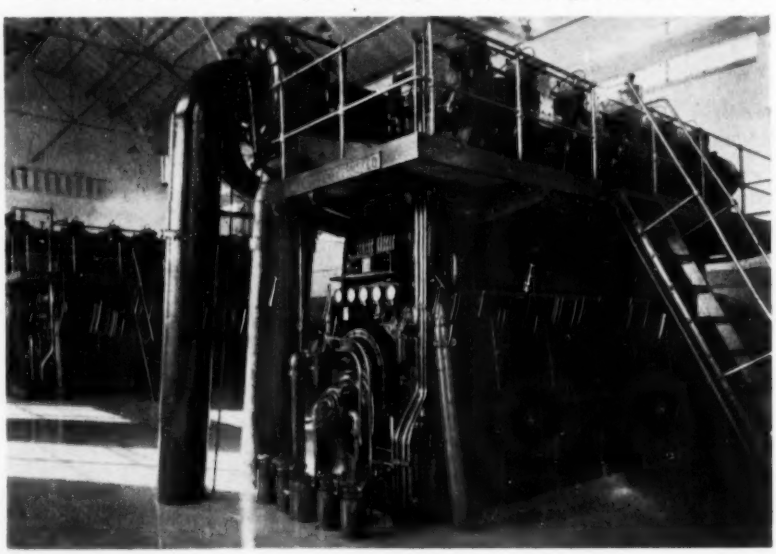
The United States still has an expanding economy and petroleum products continue to be a vital factor in that expansion. Pipeline movement of oil has increased 24 per cent since VJ day to a current annual level of 600 billion bbl.-miles. Service, with pipelines extending into 10 states, has been for decades a major transporter of petroleum, and naturally, has played its part in the industry's national expansion. Since the close of World War II, this company has laid more than 2000 miles of pipe, of which more than 500 miles have been 20-in. and almost 600 miles 16-in.

Construction of new pumping stations and augmentation of power at old stations have been a necessary part of this development program. Two 2150-hp. Fultons, six 1450-hp. Fultons and six 1575-hp. Busch-Sulzer engines were added at stations in Service's system.

At one location three new Fulton diesels have been added, two rated at 1450-hp. and one at 2150-hp. The smaller units run at 277 rpm. and drive triplex horizontal Worthington pumps through Falk reduction gears with a ratio of 4.378 to 1. The pumps have rated capacities of 2895 bbl. per hr. at 1000 lb. pressure and 3100 bbl. at 940 lb. pressure which figures to loads of 1390 hp. and 1400 hp. on the 1450-hp. engines. The big diesel drives directly at 240 rpm. a 7-plunger vertical Aldrich pump rated at 4440 bbl. per hr. at 1000 lb., a load of 1920-hp. on the 2150-hp. engine.

But new engines are not the whole story. Service's engineers believe in getting the most out of their equipment and take every means to insure long, economical, unfailing service. A

Two new 1450-hp. Fultons—6 cyl., 4-cycle turbocharged units, developing rated hp. at 277 rpm.

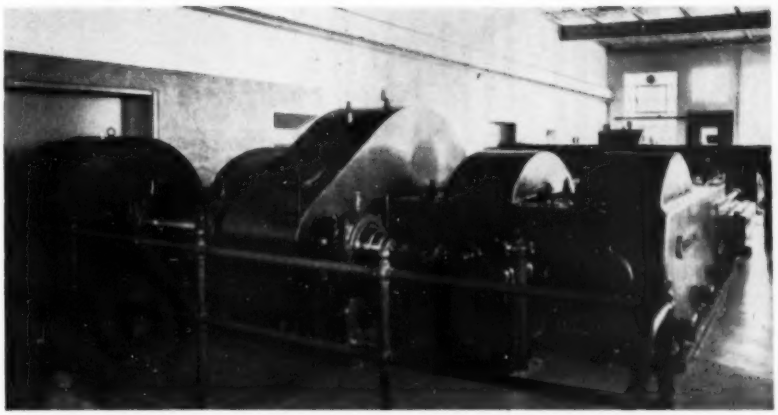


case in point is the pair of old Fulton diesels now in service at East Fort Madison. These 3-cyl. engines, rated 520-hp. at 164-rpm., were installed originally on the Wyoming line in Nebraska in March, 1925. One was moved to East Fort Madison in June, 1929, the other in July, 1932. In September, 1942, the flywheels were changed and the speed increased from 164 to 200 rpm. An Elliott turbocharger was added to one unit at the same time and to the other in November, 1944. These two changes effected an increase in power output from 520 to 930 hp. per engine.

The original liners were in service until 1944, a total of 111,522 engine hours for one engine; 97,830 hours for the other. By September 1, 1950, the first engine had been in service more than 160,000 engine hours, the second more than 148,000 engine hours. The first unit has been in operation actually more than 70 per cent of the elapsed time for 25 years. In the last 7 years, the average has been more than 87 per cent.

The causes for this impressive durability and continuity of service are multiple: good, heavy-duty prime movers; good protective accessory equipment; a careful preventive maintenance program; sound operating procedures. It can hardly be said, though, that the engines are pampered. They work a long schedule under heavy loads and have a catch-as-catch-can diet.

Fuel for the diesels is crude oil that is pumped through the pipeline. The pipeline company buys the fuel from the shippers, and an effort is made to provide mid-continent crudes when possible. At one station there is a 7000-bbl. storage tank which is filled when good crude is available. This also serves as a settling tank, for the oil is drawn off the top through an adjustable swing line to a day tank that serves all the engines through a common header. There is a duplex cartridge-type filter on each engine in addition to an edge-type filter.



1450-hp. engines drive triplex horizontal Worthington pumps through Falk reduction gears.

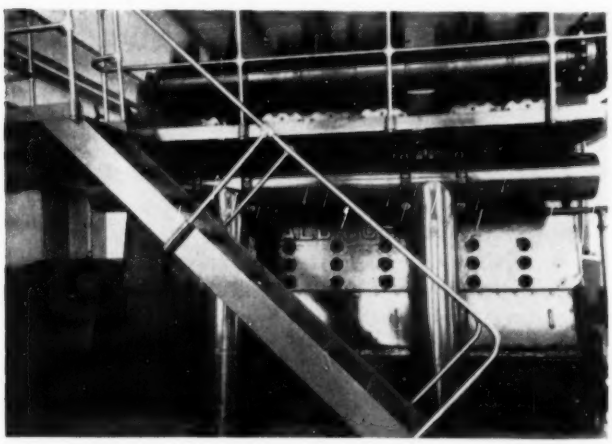
Asked what they do if they run out of good crude, area master mechanic O. C. Watson told this reporter: "We buy and use what is available." To counteract the possibly harmful effects of miscellaneous crudes on the injection system, the company specifies special steels for the injection nozzles and pump plungers.

Five of the new Fultons are equipped as dual-fuel engines and are now operating on natural gas with a small quantity of oil as pilot fuel. It is worthy of note that even a company with a ready supply of economical fuel oil can effect substantial savings through use of natural gas.

A detergent-type lubricating oil is used in all units. Some oil from the pressure-lube system is by-passed continuously through a duplex waste-packed filter. There is an oil cooler included in the lube circuit for each of the new engines.

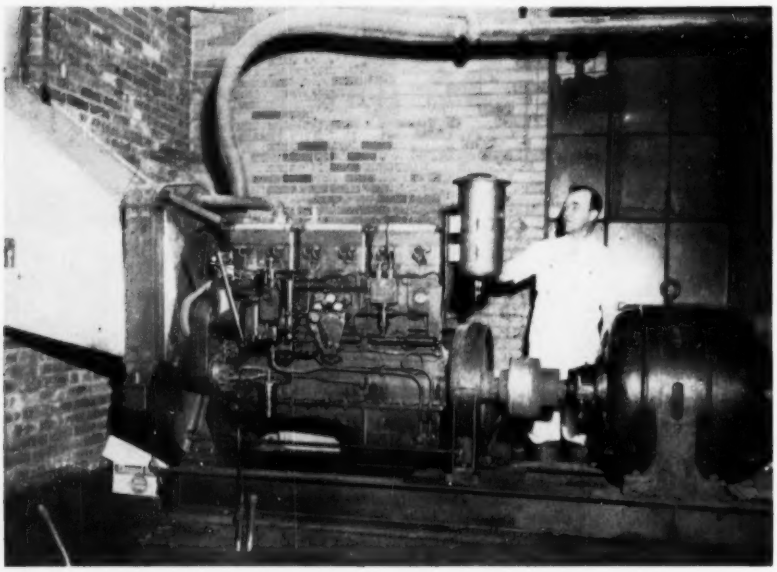
Each of the new engines has a separate closed cooling water system with soft jacket water circulated by a centrifugal pump, chain-driven from the engine. The water flows through the engine jackets and a shell-and-tube heat exchanger where it loses heat to crude oil from the incoming line. An automatic thermostatically-controlled by-pass valve at the exchanger keeps water at the desired temperature. Engine air is filtered, in the case of the 1450-hp. units, through automatic self-cleaning filters. The plants have the protection of alarm systems with alarms and indicator lights on fuel, engine lube and turbocharger lube pressures.

Obviously it is essential to keep all the engines available for service and station engineers implement a thorough preventive maintenance program. Crankcase doors are removed every 30 days for a visual inspection of shaft and bearings. Every 90 days, they make a strain gauge inspection of the crankshaft and a pull-down check with an indicator and hydraulic jack. Pistons are pulled only when necessary; bearings are inspected once a year. Needless to say, any sign of incipient trouble brings quick action regardless of the schedule.



A 2150-hp. Fulton drives this 7-plunger vertical Aldrich pump.

DIESEL BRIEFS



Dairy Farm Uses Diesel Power

Diesel Power has been an important factor in the operation of the Riggin Dairy Farm, Muncie, Indiana. A 150-hp. model HIP-600 Cummins diesel, coupled to a 50-kw. generator, powered the farm's modern equipment for 10 years. Before being placed in standby service, this diesel generator unit ran a total of 40,150 hours. For 8 of the 10 years, the engine was used an average of 11 hours a day, or a total of 32,120 hours without repair.

National Conservation Drive

Steel Founders' Society of America is pushing a national conservation drive to help alleviate the critical supply situation in iron and steel scrap.

Supplementing expanded conservation activities and revised materials handling practices throughout the steel casting industry, the society is extending its program fostering intensive collection, segregation, and economical use of scrap in a three-way campaign already under way on an industrywide basis.

Pointing up the seriousness of short scrap supply, the society literature warns that "unless the flow of scrap is greatly increased we may have a repetition of 1941, when some melting capacity was shut down due to a lack of scrap".

Diesels for Australia

Production of diesel-electric locomotives in Australia will begin shortly under an arrangement concluded between the Clyde Industries of Sydney and General Motors Corporation, Electro-Motive Division.

Initial orders cover 11 locomotives, 1500 hp., 6-axle, 4-motor type for the Commonwealth Railways, and 17 locomotives, 1500-hp., 6-axle, 6-motor type for the Victorian Railways. The total weight of the locomotive approximates 100-tons in either case. Engine and power transmission equipments will be produced at La Grange and shipped to Australia, and there assembled in locomotives built by Clyde at Granville. The first locomotive is expected to be in operation before the end of the year.

Socony Fellowships

The Socony-Vacuum Oil Company, Inc. has awarded $2000 to the University of Michigan for continuation of a fellowship in mechanical engineering during the period from September 1, 1951 to August 31, 1952.

An award was also given for that period of time to Columbia University for continuation of a fellowship in physical chemistry.

New York Diesel Fuel Tax Raised

New York State's tax on diesel fuel goes up from four cents a gallon to six cents a gallon, effective July 1, 1951, and the State Tax Commission of New York is mapping an enforcement drive to insure collection of the tax.

The Commission has announced that tax examiners have been assigned to make a state-wide check on diesel fuel sales and use, including the operations of interstate truckers.

Under New York law, owners of diesel-powered trucks and buses which operate on New York highways — whether intrastate or interstate—must register with the State Tax Commission as distributors and are responsible for payment of the diesel fuel tax.

Diesel Locomotives

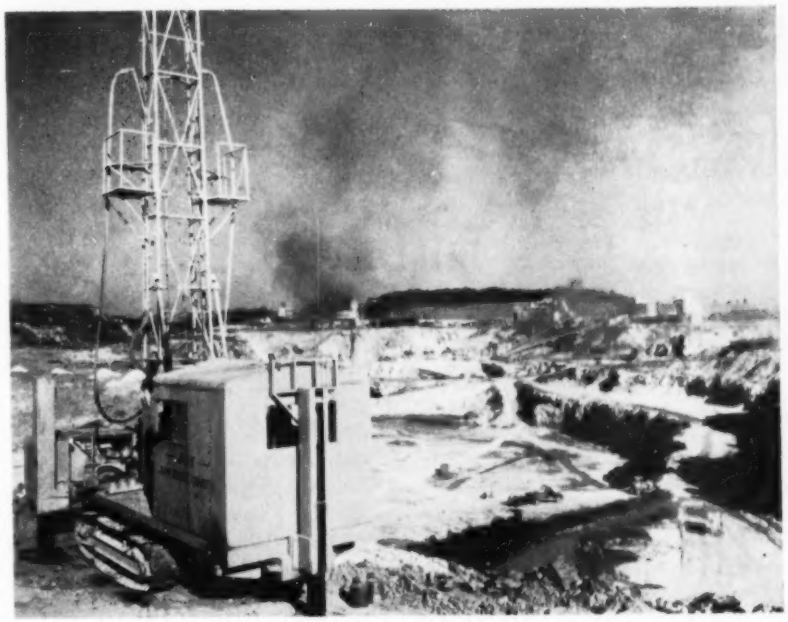
According to a current compilation by the Association of American Railroads, in the first two months of this year, the class 1 carriers installed only one steam locomotive and 407 diesels. In the similar period in 1950, only one steam locomotive and 285 diesels were put into service. On March 1, these roads had 1652 new locomotives on order, which included 1627 diesels, 21 steam and 4 electric units. The backlog was considerably larger than a year earlier, when there were 1111 new locomotives on order, which included 1095 diesels, 12 steam and 4 electric.

DIESEL BRIEFS

Detroit Diesel Training Schools

Detroit Diesel Engine Division of General Motors reports that during a two year period just ended over 8000 engine owners and mechanics attended classes in diesel engine operation and maintenance offered by the Division's three mobile training schools. The sessions were held in on-the-job locations at construction sites, mines, oil fields, lumbering camps and GM diesel distributors' headquarters throughout the country.

In 1946 a training school for distributors' personnel and other special groups was established at the factory and in 1949, it was supplemented by field training for owners and generators. Today each mobile school is transported by a truck carrying over four tons of training aids, including cutaway and "live" engines, subassemblies, movies, charts and other equipment. Free enrollment in these schools for diesel engine owners and operators is arranged through GM diesel distributors.



Diesel-Powered Drill

Thomasville Stone and Lime Company of Thomasville, Pa., reduced drilling manpower and more than doubled maximum drilling footage per day by replacing 5 small drills with this Joy "Heavy Weight Champion, a self-contained drill rig."

A 3-cyl. GM diesel engine activates the drill's rotary motion and furnishes power for propulsion, while a 6-cyl. GM activates the up and down motion of the drill and operates a compressor.

DEMA Meeting

The annual meeting of the advertising managers, sales promotion managers and public relations directors of the members of the Diesel Engine Manufacturers Association took place April 4th, at the Union League Club of Chicago.

About thirty executives of the various companies comprising DEMA were represented, and discussions pertained to the problems of the respective fields in which these executives operate.

The highlight of the meeting was a presentation at the noonday luncheon by Volney B. Fowler, assistant to the president of the Electro-Motive Division, General Motors Corporation, in charge of advertising and public relations. His subject was, "Why America needs *more* diesel locomotives *now*."

Henry J. Barbour, manager, sales promotion and public relations, Fairbanks, Morse & Company, was chairman of the meeting.

Mobile Power Plants

Eleven mobile power plants for emergency use are being readied by the Navy. Mounted on special railroad cars, each consists of a diesel-type 600-kw. generator. They will be held in standby status at various naval stations for quick transfer to locations short of power because of sabotage, bombing, or natural disaster. In addition, two 10,000-kw. steam power plants, each consisting of a six car train, are maintained by the Navy, and have been used in Mexico and Arizona for irrigation power supply.

Nordberg Distributor

E. M. Wakeman & Associates, Lakeland, Florida has been appointed industrial distributor for Nordberg 4FS diesel engines in the state of Florida and the gulf countries of Mobile and Baldwin, Alabama.

The new distributor will maintain complete coverage of its territory with salesmen located in leading industrial and trading areas of Jacksonville, Orlando, West Palm Beach, Miami, Tampa and Pensacola, Florida.

Left — First gas turbine locomotive in the United States.

Far right—Gas turbine electric power plant as installed in the locomotive.

Notes on the
Gas Turbine Electric Locomotive

*by R. A. Williamson**

THE application of gas turbines to locomotives offers the rare opportunity of dealing with an entirely different type of prime mover and using it to its fullest practical advantage. The problem was carefully studied.

Analysis made in 1941 and recapitulated in 1946 indicated that approximately 90 per cent of the locomotives in use handled freight, and of this 90 per cent, about 75 per cent were in the 4000 to 5000 horsepower range having approximately 500,000 lb. on drivers. Consequently, the new locomotive was designed within the range of weight and horsepower and for freight service.

The inherent characteristics of the gas turbine power plant for locomotive service are the usual mixture of advantages and disadvantages. On the good side, these power plants:

1. *occupy a small space—their specific weight is low.*
2. *burn low cost fuel*
3. *involve only rotating apparatus and offer the possibility of low maintenance.*

On the other side of the ledger:

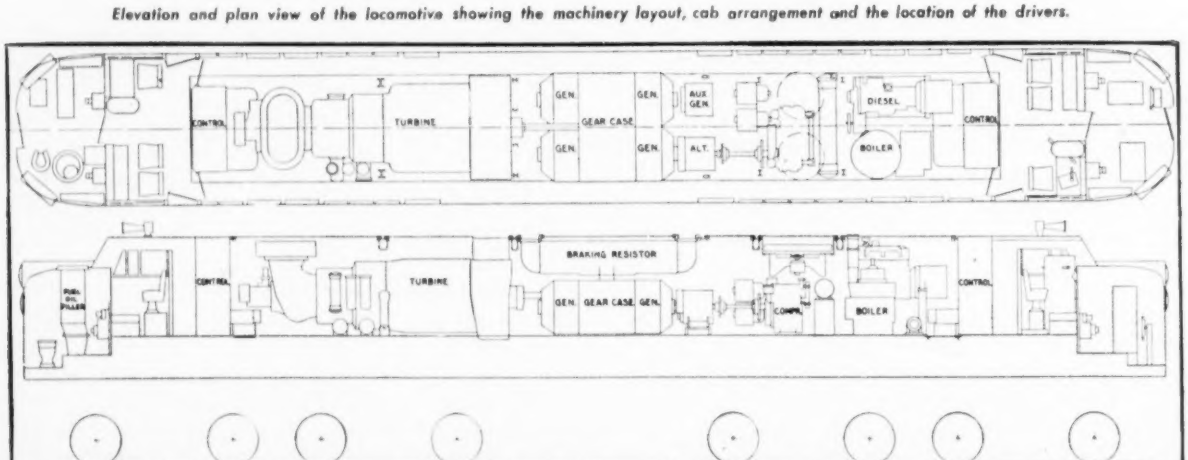
1. *they have a relatively high fuel rate*
2. *they operate at high rotative speeds, requiring a gear reduction for either the standard electric drive or direct connection to locomotive driving wheels*
3. *their output varies considerably with altitude and ambient temperatures.*

Since maintenance and first cost are, generally speaking, a function of the number of parts, it appears desirable to use the largest rating which can be installed practically in a single locomotive unit rather than a large number of smaller units.

As a result of these rather general specifications, the pilot locomotive was built as a single-cab, double-end,

*Manager, Railroad Rolling Stock Division, Locomotive & Car Equipment Department, General Electric Co., Erie, Pa.

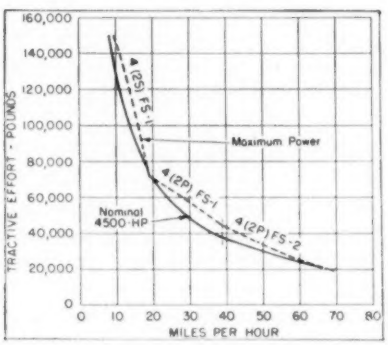
Elevation and plan view of the locomotive showing the machinery layout, cab arrangement and the location of the drivers.



B-B-B-B unit weighing 506,000 lb. with all weight on drivers. It is 83 ft., 7½ in. long, 14 ft., 3½ in. high, and 10 ft., 7 in. wide. From an operating standpoint, it is handled in essentially the same manner as a diesel-electric locomotive.

The power plant control is entirely automatic and requires little or no attention enroute. Power plant starting is not quite "push-button" starting, but approaches it rather closely. Locomotive control permits full utilization of available power up to maximum capacity of the drive.

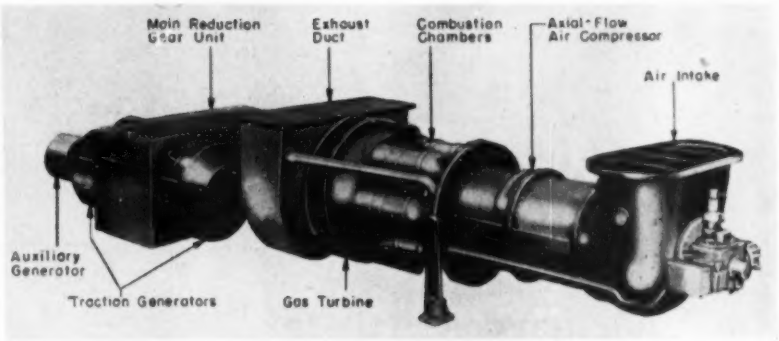
AAR statistics show that the largest single factor in boosting the average freight train's hourly transportation output is increased speed. Generally speaking, railroad operators have found use for all the horsepower locomotive builders could give them. The



Curve showing tractive effort against miles per hour at nominal and maximum horsepower.

present gas turbine electric locomotive lines up with this trend by providing more power in a lighter and more compact unit than has heretofore been available.

Up to the middle of January of this year, the locomotive had covered 90,000 miles. Of this, 79,355 have been in general freight service on the Union Pacific Railroad. During this time, the locomotive has produced 285,782 thousand gross ton miles and has burned a million and a quarter gallons of fuel, of which approximately 95 per cent has been heavier oil. During this period, the locomotive has been in service between Los Angeles, California and Salt Lake City, Utah; between Ogden, Utah, and Cheyenne, Wyoming; and between Cheyenne and Council Bluffs, Iowa. These locations cover elevations from sea level to 8014 ft. and ambient



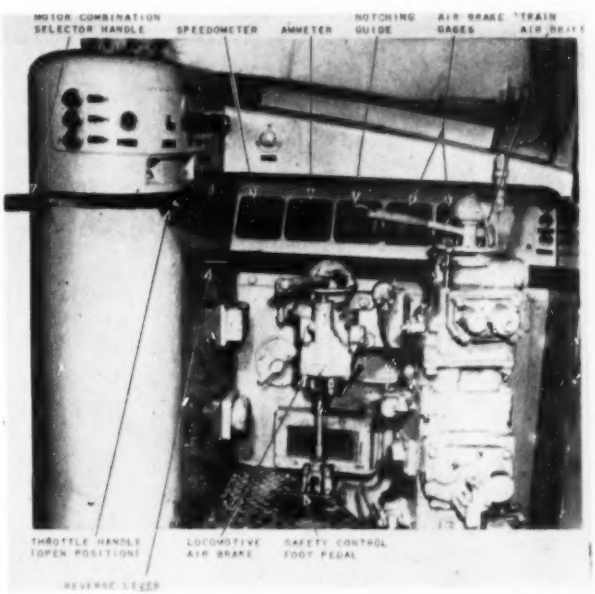
temperatures from 117° to —8° F. The service has been average freight service in this territory, except that no local freights have been hauled. Tonnages have been dictated by motor ratings on long sustained grades. On short grades the locomotive has successfully hauled 4500 ton on 1.25 per cent grade and 6500 ton on 0.7 per cent grade.

In December, 1950, the Union Pacific Railroad purchased 10 gas turbine electric locomotives from the General Electric Company. These will be essentially duplicates of the first locomotive, and will use the same power plant. They will be slightly heavier, approximately 520,000 lb., and will have increased fuel capacity, a more flexible control scheme for utilizing the auxiliary diesel-generator set for hostling movements of the locomotive, and will be built for single-end instead of double-end operation.

President A. E. Stoddard of the Union Pacific, in announcing this order, stated that the new locomotives will be assigned to regular freight service. "They will," he said, "permit the Union Pacific to evaluate more fully, under a wider variety of operating conditions, the potentialities of this new type of motive power." He further stated that the acquisition of the units was being made by the Union Pacific in furtherance of its policy of fully exploiting the possibilities of the most modern equipment developed for rail transport.

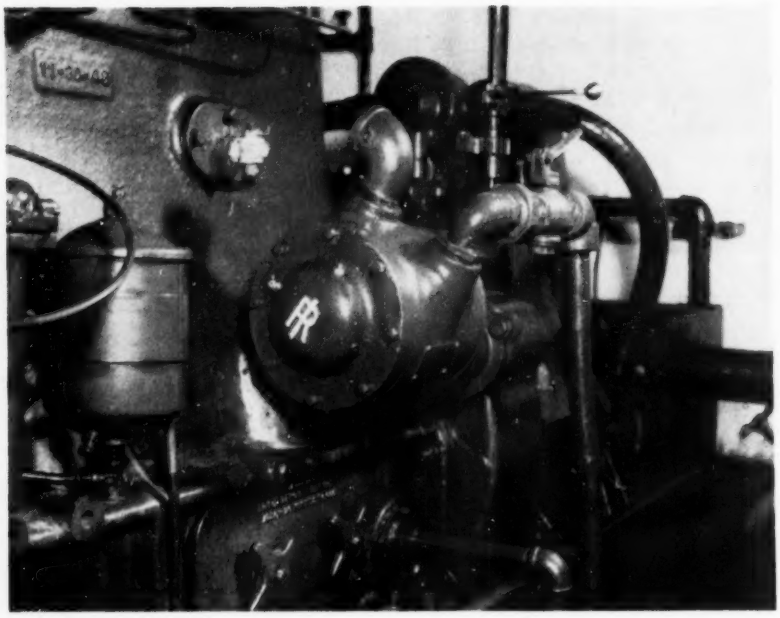
"On the basis of results to date, the gas turbine electric locomotive looks very promising as an addition to steam and diesel-electric power," Mr. Stoddard added. "Tests have been most encouraging."

Delivery of these locomotives is scheduled to begin some time during the fall of 1951.



Engineer's controls in cab of the gas turbine electric locomotive.

Air Cranking Motors



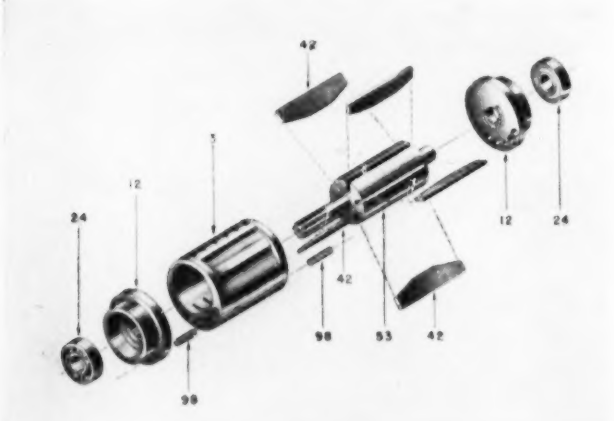
Larger of two sizes of air cranking motors is shown at right in a typical installation. On opposite page is one of the smaller units well integrated in a power unit.

AIR cranking motors are proving to be the answer to a number of troublesome starting problems. In general, such application is dependent upon an available source of compressed air or other gas at suitable pressures. However, there are many such cases where the ability to utilize this energy eliminates the complication of supplying an alternate power source simply for intermittent starting.

Typical applications are found in the oil fields where the air used in pneumatic clutches, etc., or even natural gas can be used. Another concerns large capacity, high horsepower dump trucks. These are equipped with 7½ cu. ft. compressors to provide air for steering and braking and the supply is adequate for normal starts. In cold weather when high power is necessary for initial starts, their garage or parking area is equipped with a central supply system that is connected to the trucks.

Air motors have also proven helpful in applications where an electrically started engine operates for long periods and starting is infrequent. A major difficulty in such cases is the continual problem of battery over-charging and this, of course, is eliminated.

These few illustrations will serve to show the type of applications where air motors are advantageous. What, then are the physical and operational characteristics of air motors?



Motor Parts

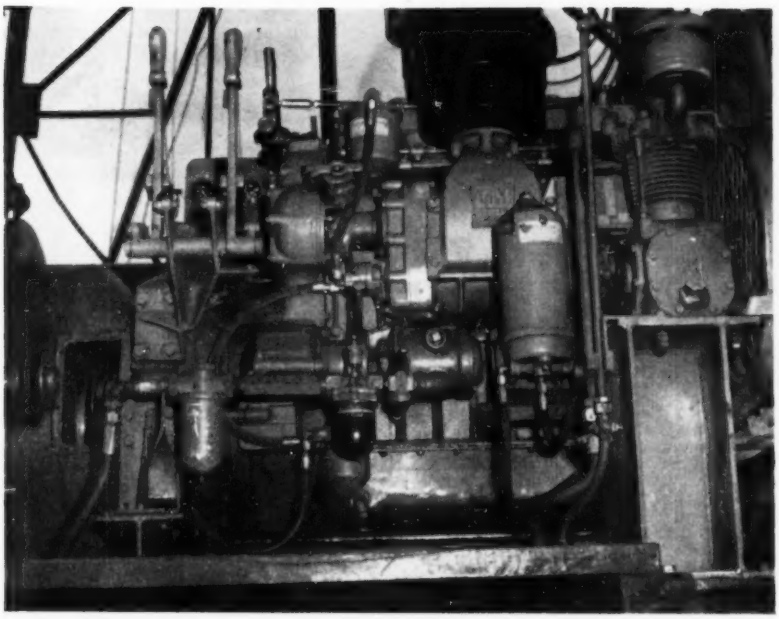
Cylinder	3
End Plates	12
Rotor	53
Vanes	42
Bearings	24
Dowels	98

There are two general types; the piston type and the vane type. Both have been successful and each has its applications. One manufacturer of such equipment, Ingersoll-Rand, has built both types, one of the first installations being that of a piston type motor for starting an engine at Montauk, Long Island, about 22 years ago.

Since that time they have standardized on the vane type motor that they have used so successfully in various tools and other items of equipment. The design is compact and rugged and thanks to the current degree of standardization of bell housings, starter mountings, flywheel ring gears, pinions, etc., interchangeability with other types of cranking motors is afforded.

The motors are extremely simple, consisting of a hardened steel rotor, a cylinder of hardened wear-resisting alloy and the enclosing bronze endplates. The rotor is slotted to receive the five vanes, these being of a special bakelite material. The vanes are of the "free-thrown" type depending on centrifugal force for contact pressure with the cylinder. Starting grooves cut in the end plates permit the pressurized air to get behind the vanes to develop initial pressure before the rotor gets up to speed.

Ball bearings mounted in the end-



plates serve to support the rotor and position it so that there is no lateral thrust and resultant wear on the endplates. The compressed air enters and leaves through ports cut in the cylinder and located over 180° apart. This, with the five vanes, produces a smooth flow of power. The vanes have been made extra wide to prevent cramping in the slots and to give maximum life.

Power from the rotor shaft is transmitted to the Bendix type drive through reduction gearing. The drive is of the heavy duty type incorporating a multidisc friction clutch that limits the maximum torque transmitted and absorbs the shock of meshing and picking up the load.

The simplicity of the mechanism is such that any mechanic can readily make any necessary repairs. The assemblies bolt together and where accurate alignment is critical, dowels are provided. Equidistant bolt spacing permits the angular relationship of the motor, gear case and the Bendix housing to be altered, for example, to clear engine projections. Rotation is unidirectional, but it is possible to obtain a reversal of pinion rotation by reversing the internal motor parts.

Lubrication requirements are at a minimum. The bearings are grease packed and the nature of the contacting surfaces in the motor are such that very little lubrication is required. A simple method of introducing oil into the air flow is illustrated.

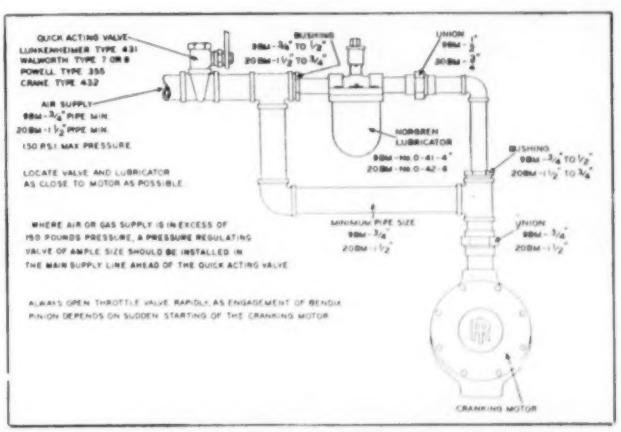
Motors are built in two sizes, and by varying the pneumatic pressure they are suitable for starting a wide variety of engine sizes. Power required for cranking is more closely a function of piston displacement than of horsepower rating. In other words, displacement more accurately indicates the starting torque requirements. Fortunately, the torque curve of the air motors is such that maximum torque is delivered at stall speeds and is thus available for "break away".

Ingersoll-Rand engineers have developed a "rule of thumb" for determining starting power requirements that has worked very well. They allow one cranking horsepower for each 100 cu. in. displacement for diesels and each 250 cu. in. displacement for gasoline engines.

The smaller motor is rated 7 hp. at 75 psi. air pressure and at the high limit, 16 hp. at 150 psi. Corresponding maximum torques in ft. lb. are 37½ and 66, respectively. The larger unit produces 19 hp. at 75 psi. and 41 at the high limit. Torque varies in this case depending on the selection between two gear ratios. Torque in ft. lb. at 75 psi. and a 2700 rpm. pinion speed is 68 and at the 1700 rpm. pinion speed, 110. At 150 psi. the torque is 127 ft. lb. at a 3350 rpm. pinion speed and 205 ft.-lb. at 2100 rpm. pinion speed.

On the basis of the displacement formula the smaller motor should handle engine of up to 1700 cu. in. displacement and the larger up to 4100 cu. in. Maximum available air pressure or the maximum desired will also be factors in motor size determination. The larger motor can be seen to produce almost double the torque of the smaller at the same pressure or approximately the same torque at one half the pressure.

The amount of air required per start will, of course, vary with the size of the motor, displacement of the engine, engine condition, frictional characteristics, etc. Also, air pressure will vary. Therefore, some generalization is necessary and since there are so many variables, average air usage is given in terms of free air. Seven cu. ft. is quoted for the smaller unit and 16 for the larger. These modest requirements permit the use of a small receiver, say 11 cu.-ft., that in most


QUICK ACTING VALVE—
LUNKENHEIMER TYPE 431
WALWORTH TYPE 7 OR 8
POWELL TYPE 355
CRANE TYPE 432
AIR SUPPLY
98M - 3/4" PIPE MIN
208M - 1 1/2" PIPE MIN
150 PSI MAX PRESSURE
LOCATE VALVE AND LUBRICATOR AS CLOSE TO MOTOR AS POSSIBLE
WHERE AIR OR GAS SUPPLY IS IN EXCESS OF 150 POUNDS PRESSURE, A PRESSURE REGULATING VALVE OF AMPLE SIZE SHOULD BE INSTALLED IN THE MAIN SUPPLY LINE AHEAD OF THE QUICK ACTING VALVE
ALWAYS OPEN THROTTLE VALVE RAPIDLY AS ENGAGEMENT OF BENDIX PINION DEPENDS ON SUDDEN STARTING OF THE CRANKING MOTOR
BUSHING
98M - 3/4" TO 1/2"
208M - 1 1/2" TO 3/4"
UNION
98M - 1"
208M - 2"
NORGREN LUBRICATOR
98M - No. 0-41-4"
208M - No. 0-42-6
MINIMUM PIPE SIZE
98M - 3/4
208M - 1 1/2
BUSHING
98M - 3/4" TO 1/2"
208M - 1 1/2" TO 3/4"
UNION
98M - 3/4
208M - 1 1/2
CRANKING MOTOR

Recommended hook-up providing for air and lubrication. Bill of materials for both size motors is given.

cases is ample for a number of starts.

Air piping to the motor is a simple matter and for operation all that is needed is a quick-opening valve. This type is necessary since sudden starting of the motor is essential to utilize the inertia of the pinion for lateral movement into engagement with the ring gear.

It is preferable that the air be fairly clean and dry, but when the unit is mounted as recommended, with the inlet at the top and outlet at the bottom, it tends to be self-cleaning and self-draining. In any case, minor impurities or moisture will have little effect on the life of the unit. As a matter of fact, considering that similar motors in production tooling operate substantially continuously for many years, these motors should outlast the engines in intermittent cranking service.

Almost any pressurized gas can be used as an energy medium. Since there is no possibility of sparking, natural gas and other inflammable gases can be used. Leakage from the cylinder is prevented by the incorporation of Garlock shaft seals and the only other precaution necessary is to pipe the exhaust to a place of safe discharge. The inherent safety characteristics of these units also make their their use possible in areas where fire or explosion hazards exist.

In summing up, it is recognized that the air motor does not have universal application. It does, however, have definite advantages where there is a source of gas at suitable pressures available for this use. The quantities used are practically insignificant.

Other practical advantages include simplicity of installation, operation, and maintenance along with long trouble-free life expectancy. There is also the safety angle and the all-important feature of interchangeability with other types of cranking equipment.

Safety Device for Pipeline Pumping

Devices for detecting combustible vapor concentrations around seals on inflammable liquid pumps has enabled installation of diesel engines and pumps in the same rooms. Substantial savings in space and construction costs result as well as greater convenience in operation and servicing.

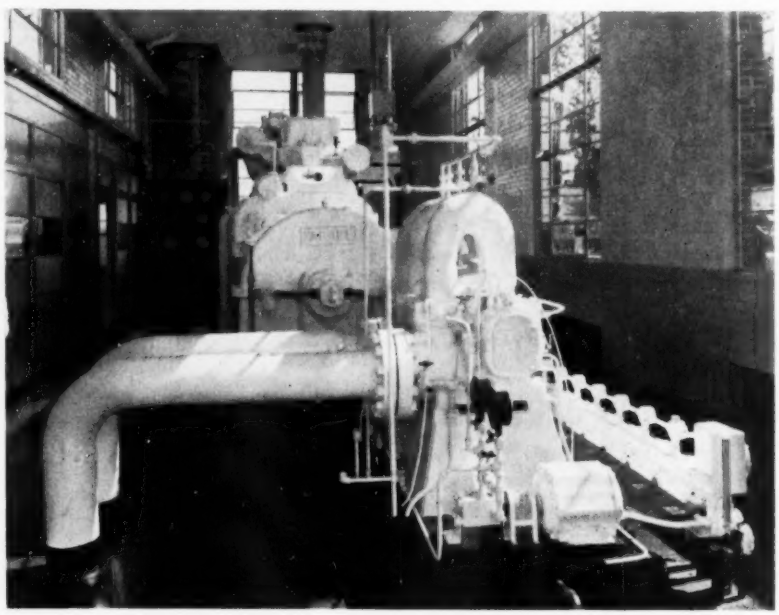
Such combustible gas detection and alarm systems are installed in five diesel-powered pumping stations on Shell Oil Company's North Products Pipe Line, running from Wood River, Ill., to E. Chicago, Ind. Seventeen products, from propane to aviation gasolines, are piped simultaneously through the 250-mile, 8-in. line.

After nearly two years of operation, sufficient to test the reliability and practicability of the system, Shell, a pioneer in developing petroleum product pipelines, recently disclosed essential safety features.

Alarms used are a development of the Mine Safety Appliances Company of Pittsburgh. Housed in an explosion-proof case and equipped with flashback arrestors, the apparatus is mounted on the main instrument panel.

Copper tubing, 3/8-in. O.D., carries air samples from the pump seal area to the analyzing instrument. A turbo-compressor with explosion-proof motor draws the samples.

Samples pass over one of two heated, sensitized platinum filaments,



Six-stage centrifugal pump driven by an Alco diesel engine. Analyzer is lowest instrument (center) on main panel. Intakes are on pump near shaft seals.

part of a balanced electrical circuit. One filament is sealed in a cell of uncontaminated air and the other exposed to the sample.

Combustibles in the sample burn on contact with the filament, increasing its temperature and electrical resistance. This unbalances the bridge circuit in proportion to the vapor concentration and deflects an indicating, contact-making meter designed to energize an alarm circuit.

This action shuts down the station completely. Calibration provides for shut-down when vapor concentration reaches 60 per cent of the lower explosive limits.

Even if the station is unattended, drop in inlet pressure at the next station gives warning of trouble. Monthly, the system is tested by simply holding a gasoline soaked rag near the analyzer intakes.

In addition to the vapor analyzers, the stations are safeguarded against high bearing temperatures, gland temperature, unduly low inlet or high discharge pressures.

Detroit Diesel Converted to Gas

DETROIT Diesel Engine Division, General Motors, has announced a new option on Series 71 diesel engines which enables them to burn natural gas in accordance with true diesel high-compression principles.

This option is available both on new engines leaving the factory and engines already in use. For the latter a factory-engineered kit is available for the changeover.

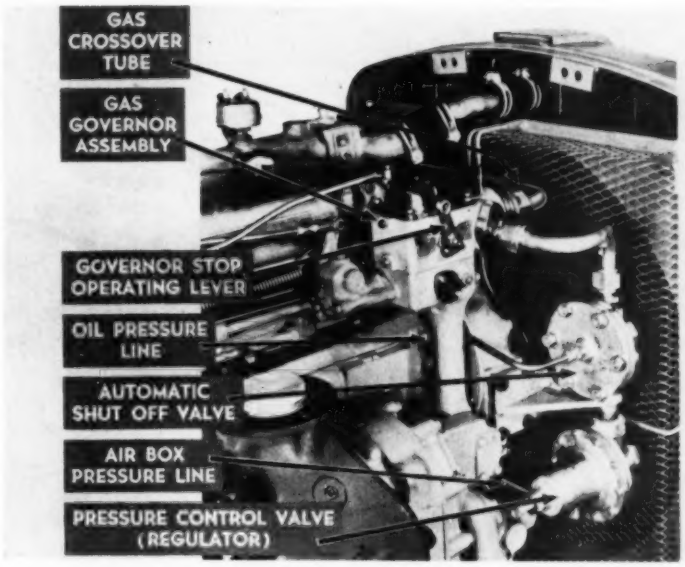
The changeover permits the engines to burn either natural gas with a pilot charge of diesel fuel or diesel fuel alone. There is no interference with the operation of the unit as a straight diesel engine when required.

Change from dual-fuel to diesel operation is accomplished instantly by moving a small lever on the gas governor assembly. When the lever is in the forward position the engine will operate either on straight diesel fuel or on gas (with a pilot charge of diesel fuel) depending on the availability and pressure of gas in the line.

This is an important feature to owners who have occasion to operate their units both in natural gas areas and in areas where natural gas is not available. The changeover permits the added economy of natural gas whenever available, and affords maximum flexibility between the two forms of operation.

The dual-fuel unit has no electrical ignition system. Natural gas is delivered to the cylinder and fired by a small charge of diesel fuel at the top of the compression stroke. The engine instantly adjusts itself between the use of natural gas (with pilot charge of diesel fuel) and straight diesel fuel in case the gas pressure falls off partially or completely. An automatic shut-off valve activated by the rise and fall of engine oil pressure cuts off the flow of gas when the engine is not in use.

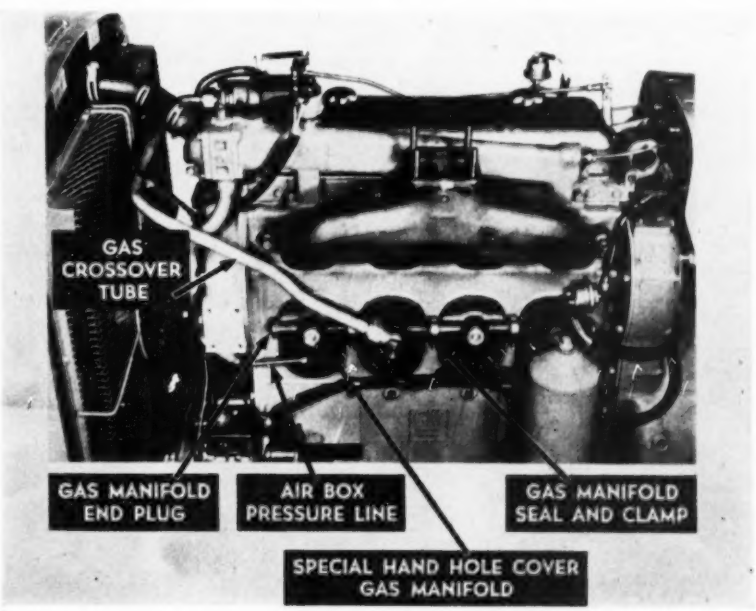
Detroit Diesel has been developing the dual-fuel engine since 1948. Engineering on the new product was completed and pilot models tested by July, 1949. Since that time, selected field applications have been made to test the engine in various industries under a variety of conditions.



Gas enters system at regulator (lower right) and passes through automatic shut-off to governor. Latter meters proper amount that enters airbox through crossover tube (see below) to mix with scavenging air.

The performance of these units on "Sour Gas" (natural gas with a high content of undesirable chemical elements) or "LP" gasses has not been fully established. To date the factory has recommended their operation only on natural gas.

According to Detroit Diesel, the advantages of the dual-fuel engine as developed in the field are added fuel economy in areas of abundant natural gas; instant changeover from dual-fuel to straight diesel operations; quick response to load (a characteristic of the GM 2-cycle diesel) and lowered upkeep due to non-sludging properties of natural gas as a fuel.


GAS CROSSOVER TUBE
GAS MANIFOLD END PLUG
AIR BOX PRESSURE LINE
GAS MANIFOLD SEAL AND CLAMP
SPECIAL HAND HOLE COVER GAS MANIFOLD

Multiple Diesel Use in Hungry

Upstream view of Hungry Horse reservoir across dam site. Capacity will be 3,500,000 acre ft.; maximum depth 500 ft. To be world's fourth largest dam, excavation of 1,000,000 yds. of rock, 65,000 yds. of dirt is involved.

A SMALL army of contractors is waging a mechanized campaign in a deep, narrow canyon upstream of rising Hungry Horse Dam, and are overcoming unique problems in clearing the 35-mile reservoir. Removal of millions of feet of merchantable timber complicates the task of preparing 22,500 acres of land for water storage. Logging, sawing, roadbuilding and clean-up crews, have been working simultaneously in the reservoir on the South Fork of the Flathead River, 20 miles northwest of Kalispell, Mont.

Located within the 2,600,000 acres of virgin timberland comprising Flathead National Forest, Hungry Horse dam site contained stands of valuable timber, which had to be cleared. As an experiment, the Bureau of Reclamation offered the timber for sale on a stumpage basis, for removal by standdard logging methods. Some 14,000 acres on the steep slopes behind the dam have been logged off, while work on other sections of the reservoir was pushed forward.

In the resulting complex operation pattern, activities center around permitting logging and sawing to continue without interruption. Clean-up crews are scheduled so as to follow-up

Roads for present and future use are being built. Left—Dozer widens road while grader clears spill for traffic. Right—Scraper moves dirt over distance too great for economical dozing.

Horse Dam Site Construction

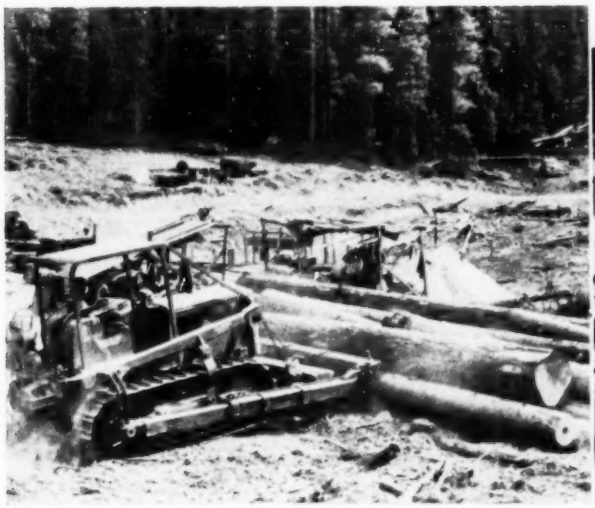
the loggers. Relocation of the road from Hungry Horse to the fire look-out station at Spotted Bear, is being completed under heavy traffic, as logs, railroad ties and rough board are hauled out.

Despite difficulties arising from the unusual requirements of the job, clearing is ahead of schedule. Much of the work has been handled by Wixson, Crowe & J. H. Trisdale of Redding, Calif., which contracted to clear 7210 acres and has comleted more than three-quarters of the task in less than half the allowed time by last fall.

Approximately 70 million board ft. of lumber has been recovered from the reservoir. Most was removed by F. K. and L. Lumber Company and Flathead Timber Products, Inc., much of the wood being sawed into railroad ties was for the Great Northern Railway. Tie-mill slabs are cut into one and two-inch board for the local market. Some logs are hauled to sawmills for manufacture into building material.

Gate closure of Hungry Horse Dam is scheduled for the fall of 1951—two working seasons away—when it is hoped to catch one million acre ft. of winter run-off water.

Clearing and logging operations. Top—Dozing debris to widen road. Center—Specially built clean-up cart dumping debris for burning. Below—At left, skidding and bunching logs. At right, portable crosstie saw mill.



Cold Weather Starting and Operation

*by A. W. Sloan, A. C. Scurlock and D. P. Herron**

IT IS NECESSARY that the Military Establishment be prepared to cope with arctic temperatures in carrying out their operations. Temperatures as low as —66° F have been recorded in Alaska, and this temperature might well be taken as the minimum which would ever be encountered.

In general, only small and medium-sized diesels are used by the military in front-line equipment which is required to operate under severe low-temperature conditions. The largest of these outdoor engines is the diesel locomotive, which may range up to 1000 hp.

Auxiliary cold-starting aid kit developed by the Air Force, which has been used for starting vehicles at temperatures as low as—60°F.

Cranking

There are several sources of power which can, with proper modification, be used to crank diesel engines at sub-zero temperatures:

Battery-Powered Starters: It is possible to use an electric starting motor at low temperatures if special batteries are employed. The sintered-plate, nickel-cadmium battery is still in the experimental stage, but holds promise of being especially well adapted to low-temperature operation.

Special lead-acid batteries also have promise of successful operation at low temperatures. The Delco-Remy Company has an experimental battery of this type which has a fairly good discharge rate down to —63° F.

Hydraulic Starters: Hydraulic starters can deliver sufficient power to start diesel engines at very low temperatures. Their two advantages over batteries are: (1) they can deliver their stored energy at high rates without appreciable loss in efficiency, and (2) they can store about the same amount of energy at low temperatures as at normal temperatures.

Pneumatic Starters: None of the present designs will deliver the required amounts of power for a sufficiently long time to ensure the starting of a medium-sized diesel engine (*at the extremely low ambient temperatures—Ed.*), and the design of an efficient air-operated cranking motor which will work at low rpm. on a variable air pressure has not yet been worked out. Thus a pneumatic cranking system for low-temperature use cannot at present be practicably employed.

Fuel-Burning Starters: Small gasoline-burning cranking motors now in use have the advantages that they will deliver an almost unlimited amount of energy for cranking at their rated horsepower and that the heat from the coolant and exhaust gases of the starting motor can be used to warm up the diesel engine before it is cranked.

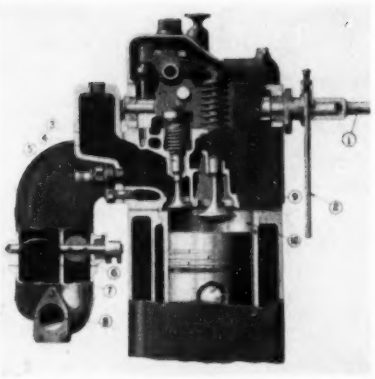
However, these motors also have some disadvantages. Present motors require the transportation and storage of gasoline, an additional fuel which presents a considerably worse fire hazard than diesel fuel. Also the starting motor itself must be started, and it may be necessary to solve the problems of starting and operation for the small motor, although most of these small starting motors can be hand cranked or started with batteries or starting cartridges.

Cartridge-Type Starters: The use of cartridge starters, in which the motor is turned over by the explosion of gases held in a small cartridge, does not appear attractive for cranking larger diesel engines. The inertia of heavy engines is so great that a large charge would be necessary to achieve the required cranking speed in one stroke. Also, the force required to accomplish this high engine acceleration would overload and reduce the life of the engine bearing.

Ignition

Auxiliary Heat Addition: In one method fuel is injected into the manifold under moderate pressure to get good atomization and is ignited with the aid of a torch or a spark plug.

* *Atlantic Research Corporation.* *Abstract of a paper presented at the SAE Annual Meeting, Detroit, Mich., January 8-12, 1951.*



International Harvestor spark ignition system of starting diesel engines.

The hot combustion products, mixed with excess air, are then permitted to enter the cylinders.

Injection of Chemicals: Another good method is to inject fluids which will ignite at low temperatures into the air intake manifold. Many substances of this type have been investigated, and diethyl ether is the best so far discovered.

Special Combustion Methods: Another approach to the problem of getting diesel engines started at low temperatures has been proposed by the Texas Company, which advocates the use of the Texaco Combustion Process. Its success depends upon creating a swirling motion in the air under compression in the cylinder, followed by injection of the fuel tangentially to the cylinder wall past an electric ignition spark.

Fuels

The following methods are available for lowering the pour points without sacrificing too much in the cetane number:

Use of Premium Fuels: One commercial petroleum diesel fuel, Standard of California Stove Oil, has a pour point below —65° F. This fuel, however, is from a limited West Coast stock. Light kerosene fuels have pour points of —65° F or below. These are also premium fuels.

Use of Dewaxed Fuels: The pour point of fuels can be lowered by removing some of the higher-boiling fractions through a solvent extraction process or a low-temperature dewaxing operation. There is a sacrifice in cetane number in using these dewaxed diesel fuels, but the lowering of the cetane number is a condition which must now be faced even in service at more normal temperatures, because of the oil industry's tendency to substitute cracked stocks for straight-run paraffins.

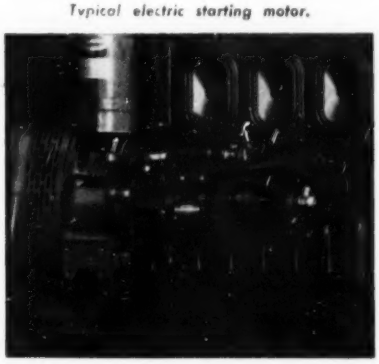
Use of Additives: The use of additives to lower the pour point, although having some merit, does not generally lower the cloud point a proportionate amount. Since the presence of wax crystals below the cloud point tends to clog the filter and injection systems, it is desirable to use fuels at temperatures above their cloud points. Nevertheless, pour point depressants may at times be more economical than further dewaxing or use of lighter fuels.

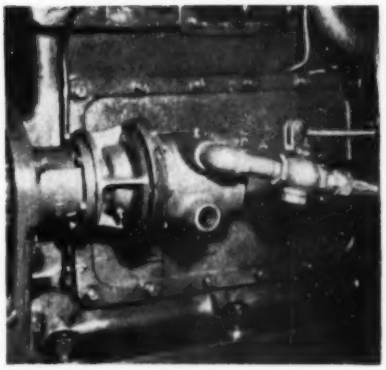
Lubrication

Synthetic Lubricants: If it were not for the price and availability, the use of synthetic lubricants or blends of these with petroleum lubricants would offer the best solution to low-temperature lubrication problems, as these lubricants have outstanding properties. They have lower pour points (—80° F), higher viscosity indexes, lower decomposition rates, and leave the engine in better condition.

Dilution: Especially with gasoline engines, it is common practice in the field upon shutting down during cold weather to dilute the lubricating oil with gasoline. The viscosity and pour point are thus lowered so that later, when the engine has cooled to ambient temperatures, the oil is sufficiently thin to allow the engine to be cranked. During further operation of the engine, the volatile material evaporates and supposedly leaves the oil in its original condition. There is considerable controversy over the merits of such dilution.

Typical electric starting motor.





Starting motor of the air driven type.

Dry Sliding Surfaces: Engineering Research Associates, Inc. has found that two nickel-oxide surfaces in sliding contact operate with an extremely low coefficient of friction and can function for long periods of time without appreciable wear. The data on the bearings are scanty, however, and no low-temperature tests have yet been run.

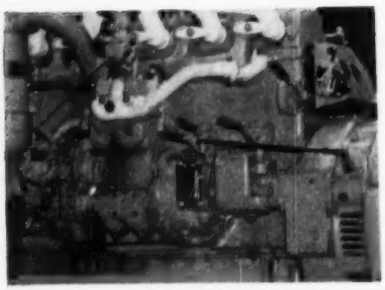
Coolants

Most probably liquid cooling will continue to be used instead of air cooling systems, since the liquid method has the advantages of (a) high heat capacity per unit volume of liquid, (b) high heat transfer coefficients, (c) easy adaptation of the system so that heat can be carried to cold parts of the engine, and (d) better heat economy when the coolant is used to carry excess heat to engine cold spots.

Engine Design and Materials

The Fuel System: Fuel pumps require improvement to make them capable of handling more viscous fuels at the lower temperatures. Consideration should be given to overhaul of the fuel injection system with the objectives of: (a) improving fuel atomization at low cranking speeds and high fuel viscosities, (b) incorporating a priming device which will allow injection of additional fuel during cranking, and (c) allowing variable timing of the fuel injection.

The Lubricating System: The lubricating oil pumps should also be rede-



Gasoline engine starting motor mounted on side of diesel engine.

signed so that oils varying in viscosity over a wide range (up to about 40,000 SUS at the lower temperatures and down to 30 SUS at the higher temperatures) can be successfully handled.

The Cooling System: Perhaps one of the most important changes that must be made to assure satisfactory operation at low temperatures is to redesign the cooling system on the principle that the coolant should not only be circulated to remove heat from the engine hot spots but must also deliver heat to regions where it is needed.

Miscellaneous Considerations: In designing an engine that is to be started and operated at very low temperatures, the effect of this low temperature on clearances must be taken into account, and consideration must be given to design changes required to reduce engine wear due to condensation of moisture and combustion products. Designs must also be modified to accommodate any auxiliary heating equipment, starting devices, and apparatus for the injection of starting fluids.

Controls on the engine and auxiliary equipment should be modified to allow their manipulation by personnel wearing heavy gloves. Provisions should be made for adequate instrumentation for low-temperature starting and operation.

Except for problems of fan belts, flexible hoses, and electrical insulation, no serious difficulties associated with diesel engine materials of construction have arisen in arctic service. At present it appears that a new polymer of butadiene and styrene referred to as "90:10" will be satisfactory for fan belts and flexible hose for use at very low temperatures, but further work is necessary to get a completely satisfactory electrical insulation and oil-resistant rubber.

Stand-By Heaters

If, when an engine is shut down during cold weather, enough heat could be supplied to compensate for heat losses to the surroundings, the temperature of the engine and its auxiliaries could be maintained at a high level and the engine could be started immediately even after long periods of idleness. With effective insulation, a diesel engine of moderate size at a temperature of, say 35° F under conditions of zero wind velocity and an ambient air temperature of —65° F would lose heat to the surroundings at the rate of about 5000 Btu per hour. Even with a wind velocity of 50 mph, this loss would only be increased to about 20,000 to 25,000 Btu per hour. Thus if coolant circulation can be obtained, a small coolant heater burning less than one pound of fuel per hour can furnish enough heat to maintain a diesel engine of moderate size at a relatively high temperature and ready for instant starting.

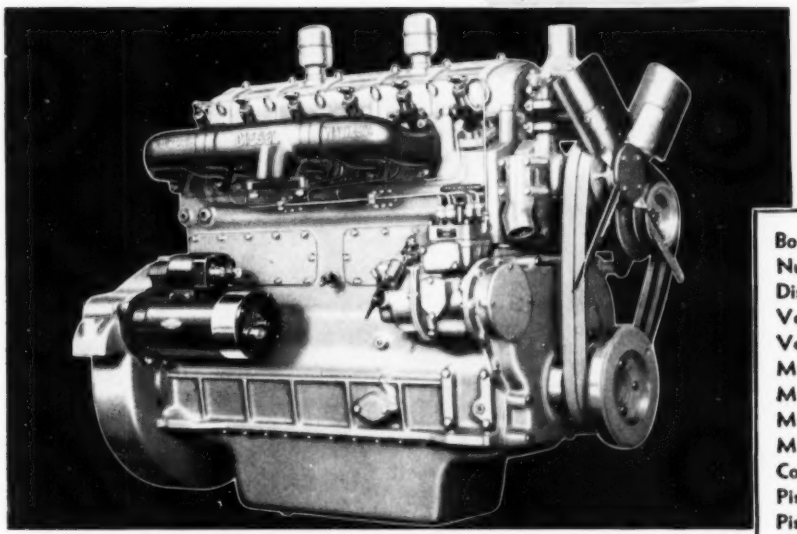
Although stand-by heaters do not appear as attractive as "quick-start" heaters for use on diesel equipment required to operate in the Arctic, it appears that reliable stand-by heating systems will continue to have many important applications. Work on the improvement of these systems might well be continued with emphasis on increasing the reliability, improving the temperature control at the critical

(*Continued on page 79*)

SUMMARY OF LOW-TEMPERATURE PROBLEMS AND REMEDIES EMPLOYED

	Problems	Remedies	Best Solutions
Cranking:	1. Electric starters drain batteries excessively. 2. Gasoline starters themselves are hard to start and require different fuel.	1. Use special battery. 2. Use hydraulic starter. 3. Use pneumatic starter. 4. Use special gasoline starter. 5. Use diesel-powered starter which can be cranked. 6. Use cartridge starter.	1. Use special lead-acid battery. 2. Use sintered-plate nickel-cadium battery down to -40° F. 3. Use gasoline starting motor which can be hand-cranked. 4. Use hydraulic starters.
Ignition:	1. Most fuels not ignitable at low temperatures.	1. Burn fuel in air inlet to heat air. 2. Inject diethyl ether into air manifold. 3. Use gasoline and spark ignition initially. 4. Use special fuel-air mixer and spark.	1. Use diethyl ether.
Fuels:	1. Most commercial fuels are solid at -45° F.	1. Use pour point depressants. 2. Use kerosene fractions. 3. Dewax commercial diesel fuel.	1. Use premium diesel fuels down to 40° F. 2. Use kerosene stocks or de-waxed stocks to -65° F.
Lubrication:	1. Pour points of most lubricants are about 0° F. 2. Viscosity index of most oils is too low.	1. Use de-waxed or low-paraffin stocks. 2. Use pour point depressants. 3. Use synthetic lubricants. 4. Use special unlubricated surfaces.	1. Use synthetic lubricants.
Coolants:	1. Water-base coolants do not have low enough freezing points. 2. The alcohols are too volatile or lack necessary stability.	1. Use lubricant-type liquid as coolant. 2. Use ethylene glycol-water or butyl alcohol-water mixtures.	1. Use one of synthetic lubricants as coolant.
Engine Design:	1. Fuel pump and oil pump are under-designed. 2. No way to heat fuel & lubricants readily. 3. Electrical insulation & rubber crack at low temperature.	1. Use dry-oil sump to heat lubricant quickly. 2. Use synthetic rubber V-belts. 3. Use engine designed specifically for low-temperature work.	1. Use engine designed specifically for low-temperature work.

A *New* WAUKESHA Transport *Diesel* Six



MODEL 135-DKA

Bore x Stroke	4¼ x 5
Number of Cylinders	6
Displacement, cu. in.	426
Valve Diameter, clear, intake	1¾
Valve Diameter, clear, exhaust	1½
Main Brg., Front, dia. x lgth.	3¼ x 1 13/16
Main Brg., Center, dia. x lgth.	3¼ x 2⅜
Main Brgs., Inter. (4), dia. x lgth.	3¼ x 1 13/16
Main Brg., Rear, dia. x lgth.	3¼ x 2½
Conn. Rod Brg., dia. x lgth.	3 x 1⅜
Piston Pin, floating, dia. x lgth.	1½ x 3⅜
Piston Rings, Comp. (3), face width	⅛
Piston Rings, Oil Control (1), face width	¾
Timing Gears, face width	1¼
Flywheel Housing, S.A.E. No.	3

All dimensions given in inches unless otherwise stated.

...with all these modern features, this engine is suited for high speed metropolitan and suburban delivery service as well as high speed highway transport. A full Diesel four-cycle engine, its patented spherical combustion chamber permits it to burn all modern high speed Diesel fuels from 45 cetane up.

Cylinder Head—Alloy iron casting in which are mounted removable combustion chambers, valves and valve operating mechanism. Both valve seats are Stellite inserts.

Crankcase—Deep, rigid, combination crankcase and cylinder block, sturdily braced by the seven bearing bridges and the outside longitudinal rib and struts at the base. Large openings give access to coolant jacket for inspection and removal of scale and sludge.

Cylinders—Renewable dry liners of hardened alloy iron, honed to fine finish.

Pistons—Aluminum alloy with four rings, all above the piston pin. Three compression rings, K-type; one oil control, square section. Top ring is chrome plated.

Piston Pins—Extra large, hollow, hardened and lapped finish. Full floating.

Crankshaft—Seven-bearing, drop-forged, heat-treated steel. Crankpins and main journals are hardened (500-600 Brinell), ground, and polished. For high speed (2800 rpm) and peak output operation the crankshaft is counter-weighted and fitted with torsional vibration dampner. Shafts are statically and dynamically balanced to 4 10 inch-ounces.

Connecting Rods—Rifle drilled, heat-treated drop forgings. Large bearing is steel backed copper-lead precision shell—small end has hard bronze bushing.

Main Bearings—Precision type, steel backed, copper-lead shells; heavy, ribbed caps and heat-treated bolts.

Valves and Seats—Both intake and exhaust valves are Stellite-faced alloy steel forgings operating in renewable guides. Both valve seats are Stellite inserts.

Timing Gears—Wide-faced, helical-cut timing gears are mild steel and cast iron.

Lubrication—Full pressure by gear-driven gear-type pump to main, rod, camshaft, and piston pin bearings. Metered intermittent pressure to timing gear spray, rocker arms and valve chamber. Flood oiling to cams and tappets from valve chamber spill-back; cylinders and pistons are lubricated by crankshaft throw-off. Pump has floating intake screen to insure only clean oil is drawn from the clear top layer of the oil supply.

Oil Filter—Large waste-packed oil filter bolted to the crankcase is shunt-connected; cleans oil continuously.

Cooling—Efficient belt-driven pump-and-fan, flange-mounted at the front of cylinder block provides positive circulation of coolant. Thermostat assists in fast warm-up, and maintains proper jacket temperatures.

Injection System—American Bosch flange-mounted injection pump with drawn steel injection lines to American Bosch single orifice pintle nozzles.

Fuel Feed Pump—Diaphragm-type primary pump mounted on camshaft side of crankcase is positively driven from eccentric on camshaft. Hand lever for initial filling of fuel system.

Fuel Filter—Adequate protective fuel oil filter.

Governor—Waukesha-type centrifugal governor incorporated in fuel injection pump. It is fully enclosed, self-lubricating and non-hunting.

Starters (Extra)—Electric starting, 12-volt system with belt-driven generator, regulator and details; Chevron primer is also available as "extra" equipment.

Send for Bulletin 1573. Consult Waukesha Engineers about all your engine requirements. No obligation.

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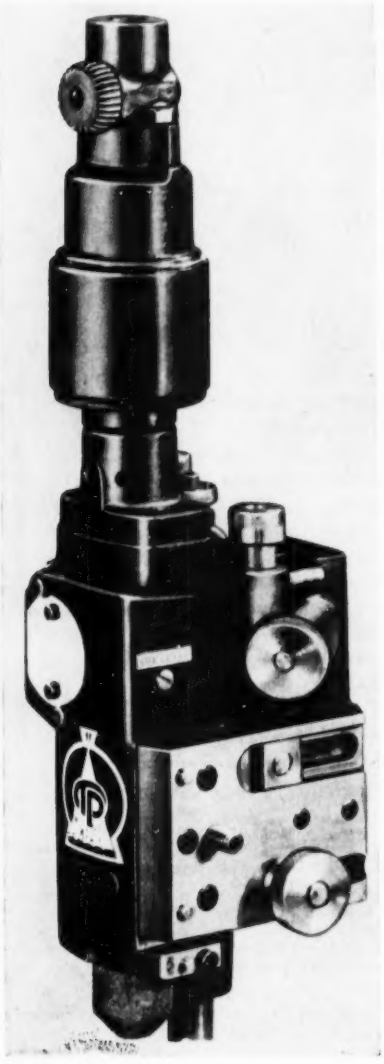
WAUKESHA MOTOR COMPANY, WAUKESHA, WIS. • *New York, Tulsa, Los Angeles*

New Products



Portable Valve Seat Grinder

A new portable valve seat grinder, especially designed for large internal combustion engines with inside seat diameters from 2-15/16 to 12 in. has been developed by Thompson Products, Inc. The unit can be used for grinding both valve seat faces and counterbores within the size range, and regularly holds concentricity to .003 in.

The new portable grinder is of simple design and construction, and may be used in the shop or directly on the engine—wherever air pressure is available. It consists essentially of a grinding unit with easily accessible controls, a wheel dressing unit, and an air motor drive. The grinding unit is driven at 10 rpm. around a pilot centered in the valve guide, with the grinding wheel operating at 12,000 rpm. Only a small portion of the wheel contacts the seat surface, eliminating egg-shaped seats, chatter, and downtime for wheel dressing. Greater accuracy and a smooth, low microinch housing and wheel dressing unit are of cast iron to absorb vibration.

The wheel dresser is attached directly to the grinding unit for the wheel dressing operation, thus permitting dressing wheels without removing the grinder from the pilot. A diamond tool, which performs the dressing operation, and any angle from 0° to 90°, can be obtained.

Another important feature of the grinder is the air motor which drives the grinding unit. It provides the greatest horsepower per pound of weight (3-½ lbs.) and produces high initial torques. Air pressure from 90 to 125 psi. from a high volume tank is recommended. Air operation of the grinder is an important safety feature when using the unit in gasoline plants, compressor stations or wherever a fire hazard exists.

New Loading Resistors

A new portable loading resistor (Type 17EM55D2) for load testing diesel-electric locomotives up to 2500 hp., has been announced by the General Electric Company's Locomotive and Car Equipment Divisions. The resistor is rated at 3450 amps. continuous, and 4000 amps. for 15 minutes.

The unit was designed for run-in tests, "running-in" new bearings and similar parts, setting generator current limit, and setting diesel horsepower obtained over the constant horsepower portion of the generator characteristics. The new resistor is a completely self-contained unit, requiring no external mechanical, liquid, or electrical connections except the power cables connecting the locomotive and the resistor. Resistor loading is constant, not varying from cold to hot. Mounted, the loading resistor is easily moved by a battery truck, and can be used indoors or outdoors.

Torque Wrenches

A new series of torque wrenches for ⅜, ½ and ¾ in. square drives is being manufactured by Bonney Forge & Tool Works. The new torque wrenches features a broad, pre-tested tension bar and, because of their long, thin design, they provide easy access to tight spots. Handles are pivot-mounted to maintain a constant leverage radius. Easily read calibration scale is available if foot-pound or inch-pound calibrations are desired.

Heater for Shops

A solution for the heating problem that faces many garages and service stations during winter months is reported through the use of Thermoblocs, self-contained, direct-firing heating units.

Thermoblocs are particularly well adapted for use in buildings with large, open interior spaces. By constantly circulating heated air at working levels under automatic controls, they are able to maintain even temperatures in buildings having heavy in and out traffic. Where building size and traffic requires, it is sometimes used for a heat curtain at doorways to warm the inflow of cold air. No complicated or expensive pipe, duct, or radiator installations are required. Either floor set or ceiling suspended types are said to heat up a working area in about five minutes after starting.

Thread Restorers

Herbrand Tools has recently announced a new set of 8 sizes of thread restorers.

It is claimed that these new dies restore threads quickly on any battered, damaged or rusted bolt, stud or shaft. Each die is the same size as the matching nut. No special holder or tool is required . . . uses regular wrench or socket.

New Steady Rest

A new steady rest for mounting extra large work in the lathe has been announced by the South Bend Lathe Works. Now available for the 16 and 16-24 in. South Bend Lathes, this steady rest takes work between 4-¾ and 10-¾ in. in diameter. It is especially suited for machining pipe, pressure cylinders, pump and engine cylinders, and similar large diameter work that is not excessively heavy.

Synthetic Seals

O-rings and other precision molded seals may now be obtained in a newly developed extreme temperature range synthetic rubber compound from the Parker Appliance Company.

Resistant to non-fuel petroleum products such as lubricating oils and hydraulic fluids, the new compound, Parker 42, functions effectively in sealing performance anywhere in the temperature range of from -85 to +275°F. The compound is also said to be satisfactory for service with ozone, having an ozone resistance of 0.003 per cent for six hours.

Other physical characteristics of the new formulation are: tensile strength 2000 psi.; elongation 300 per cent; shore A hardness 60± 5°; and permanent set 3 per cent.

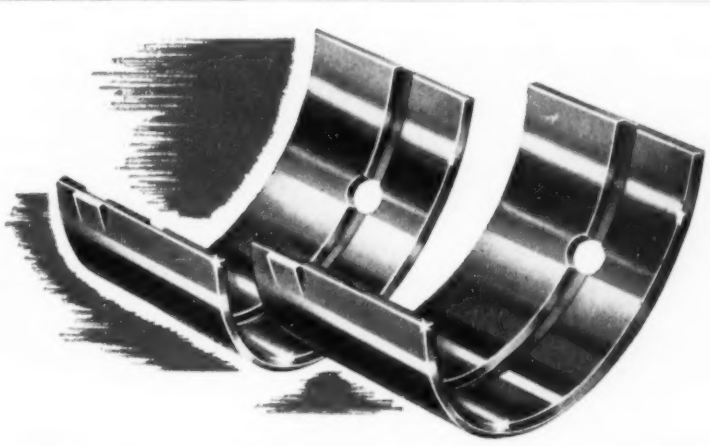
New Galvanizing Method

A new method of cold galvanizing for surface protection of steel and iron has been announced by the Chase Chemical Corporation. It is claimed that the extensive testing over a two-year period has proved that the process, which utilizes Zinkrich cold galvanizing compound, equals and in many cases exceeds the performance of other surface protection techniques including electroplating, hot-dipping, cementation, spraying and painting.

Filling Signal

Ventalarm refueling signal, manufactured by the Scully Signal Company is now being applied to diesel-electric locomotives. This device is said to eliminate overflow spillage, and to expedite refueling of engines.

When fueling starts, venting vapors forced out of the tank by the incoming liquid blows a small and sensitive whistle incorporated in the Ventalarm signal assembly. This whistle blows continuously until the rising liquid seals the signal intrusion tube, which projects into the tank a predetermined distance. When the whistle stops the tank is filled to the desired level.



Master Engine Mechanics Prefer MONMOUTH

TODAY'S Diesel power plants in marine, vehicle and stationary use are the finest engines of their type ever built.

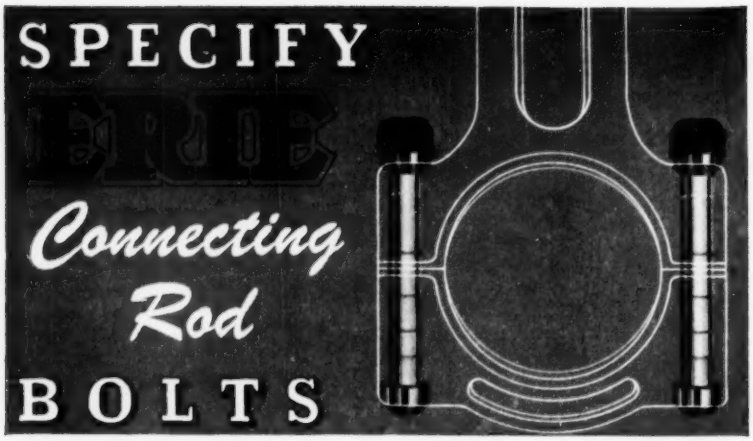
Master designers and makers of these fine engines specify and use only top quality components, including CGB bearings of the proper type and construction.

Should bearing replacement become necessary, master engine mechanics maintain the high standard of engine performance with Monmouth Bearings. These bearings are identical in every detail with the original bearings. They excel all others in finish, in precision, in quality and in engineered performance.

In the maintenance of Diesel engines—whether marine, stationary, or in prime movers—specify genuine Monmouth Engineered Bearings.

Monmouth Bearings are engineered and precision made to safeguard the reputation of the master Diesel engine mechanics and to insure user safety and satisfaction.

THE CLEVELAND GRAPHITE BRONZE CO.
REPLACEMENT SALES DIVISION
6545 Carnegie Ave. • Cleveland 3, Ohio



Send your specifications for precision bolting to **ERIE**, headquarters for special bolting since 1913. This long experience with alloys, steels, latest heat treatment and most rigid machining and threading tolerances is at your service. It pays to entrust vital bolting to folks who do this kind of work day in and day out. Hundreds of heavy machinery manufacturers like to do business with **ERIE**. Try **ERIE** for *your* next special bolting requirement.

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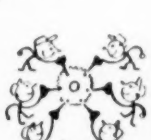
Manzel AUTOMATIC FORCE FEED LUBRICATION

FREES MANPOWER FOR MORE PRODUCTIVE JOBS

Meters the precise amount of oil needed

Reaches vital parts ordinary methods can't lubricate



Gives each wearing point a full-time 'oiler'

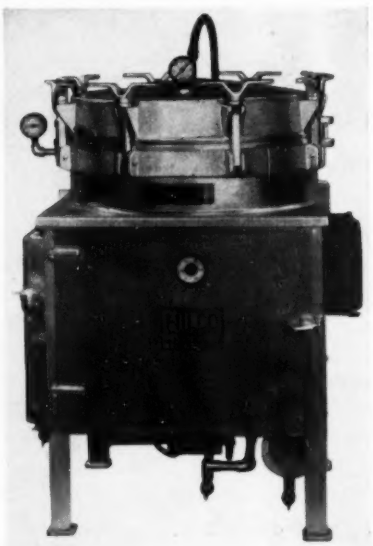
Manufacturers using Manzel Lubricators report that they save their initial cost many times over in reduced labor cost, lower oil consumption, and fewer breakdowns. "Manzels" are standard equipment on many makes of engines, pumps, compressors, hydraulic presses, conveyors, and other machinery. Or . . . you can install them on present equipment.

Manzel representatives will gladly supply technical assistance on lubrication problems.

Manzel
Division of
FRONTIER INDUSTRIES INC.
271 BABCOCK ST. • BUFFALO, N. Y.

Oil Reclaimers

Hilliard is producing a new line of Hilco oil reclaimers. The units feature improve design including rotary type pumps, high capacity regenerative heat exchanger, new vacuum pump lubricating system and general re-arrangement for ease of servicing and longer equipment life.



The reclaimers are used for the reclamation of diesel and gas engine compressor lubricating oils. The process consists of first filtering your oil through a bed of Hilite fuller's earth for straight-run mineral oils or Adstay filter discs for heavy-duty detergent type oils. After filtering, the oil flows into a vaporizer where all traces of water, moisture and fuel dilution are removed and then the oil passes through the high capacity regenerative heat exchanger where heat is transferred to the cold incoming oil. The vapors resulting from the condensation of water and fuel dilution pass to a distillate receiving tank. These units are continuous and automatic in operation and are available in capacities ranging from 2- up to 500-gph.

New Battery

The Socony-Vacuum Oil Company, Inc. has brought out a new storage battery that will make possible savings of approximately 10 per cent of sulfuric acid and 15 per cent of lead,

both critical materials at the present time.

The battery simply makes use of the principle of reducing the full charge gravity of the battery from the usual 1.280-1.300 range to 1.260. This weaker fluid saves acid as well as being easier on the plates. Designated as the 210 (2.10 volts per cell with 1.260 solution), it has a slightly lower initial capacity and 14 per cent longer useful life.

Thermostatic Controls

The automatic regulation of jacket water and lubricating oil temperature can be achieved by thermostatic control valves, manufactured by American Motors Company. These controls are made in a variety of sizes from ½ in. to 6 in. The 2-½ in. to 6 in. units all operate on the same principle as the 2 in. unit, except that multiple elements are used to take care of the increased flow. The elements are all identical for the 2 in. through the 6 in. thermostats and provide a

factor of safety by the use of multiple elements in the same housing.

New Piston Ring

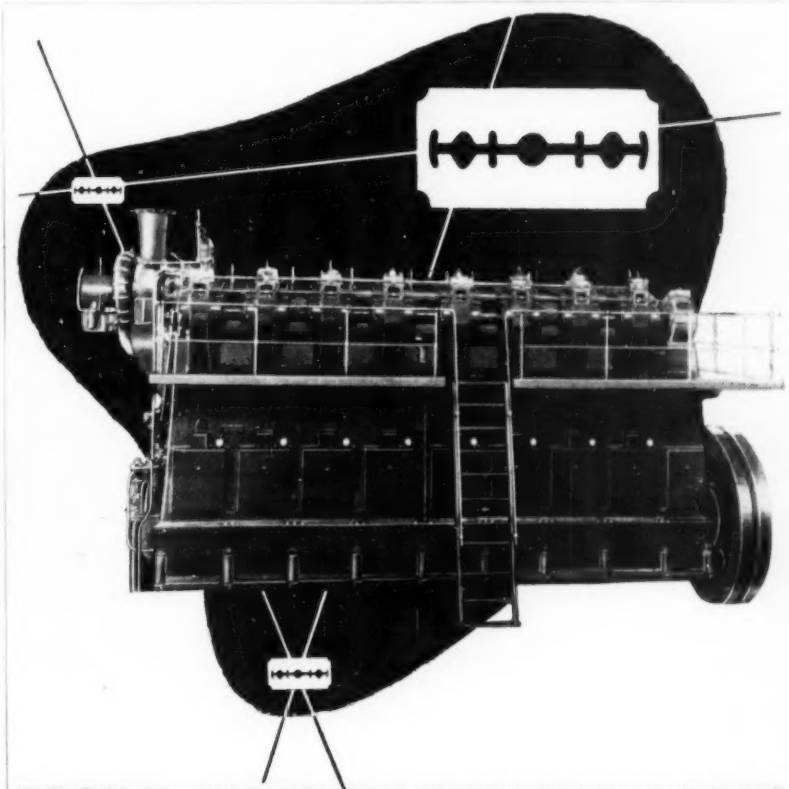
A new one-piece sealing ring, called the Inseal, with the sealing member located on the inner side of the ring, is available (in diameters from four to 96 inches) from the Double Seal Ring Company. As it seals fully from both sides, it is suitable for use on single-groove, double-acting pistons.

The feature most important to operators generally, according to the manufacturer, is the location of the sealing member on the inner periphery

of the ring. The ring exposes only one material to the cylinder wall, thus helping eliminate undue wear of insufficiently lubricated cylinder walls.

Location of the sealing member on the inner side permits making the member from stronger materials, which, because of their propensity to wear, are not feasible for use in contact with cylinder liners. Possibility of breakage of the member is said to be greatly lessened.

The Inseal is recommended by the manufacturers for use in place of any presently used rings in two- and four-cycle gas and diesel engines, steam engines, air and gas compressors, pumps and hydraulic and pneumatic machines. Since it is a semi-locking ring, it is suitable for use in ported engines.



EASILY INTERCHANGEABLE PARTS

. . . cut FULTON maintenance costs to the bone

Every working part of every FULTON DIESEL is precision-finished to such close tolerances that replacements (seldom needed!) are quick and simple.

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your best buy in the long run

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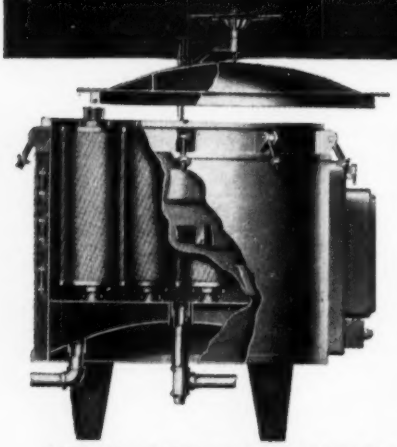
THE CHOICE
OF MORE AND MORE
ENGINE BUILDERS AND OPERATORS



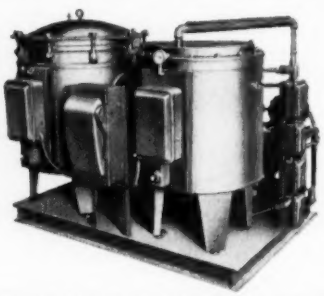
HOFFMAN
FILTRATION EQUIPMENT

Designed to meet your needs . . . built to give you the service you want . . . with maximum economy and convenience of operation proved in scores of installations.

As buyer or builder of diesels, it will pay you to get complete details on the Hoffman filtration line. Literature and data are yours for the asking—TODAY.

HOFFMAN CARTRIDGE FILTERS FOR DIESEL FUEL AND LUBE OIL.
Feature a new high in modern, efficient design. An exclusive cover-lifting device simplifies cartridge removal. Swing bolts fasten the cover — assure quick, easy cartridge replacement. Available in two series, for either 7 x 18 Navy size throw-away cartridges in multiples of 1, 2, 4, 7, 9, 14 and 18 cartridges. Or, for 11 x 18 cartridges, either re-packable or throw-away types, in multiples of 1, 2, 3, 4, 6 and 8 cartridges. Provide continuous clarification on shunt or by-pass basis. With or without heaters and controls.

COMPLETE PURIFICATION OF USED LUBE OIL IN THE HOFFMAN OIL CONDITIONER
Save yourself the high maintenance cost of centrifuges. Removes both insolubles and solubles (oil, gas, moisture, fuel dilution). Only two moving parts . . . no steam or water connections. Models with capacities from 50 to 600 g.p.h.



HOFFMAN DISC FILTER
Three sizes of this compactly designed filter to handle 1 to 10, 5 to 50, and 50 to 125 gallons per minute. Removes impurities from 3 to 5 micro inches. Low first cost . . . no moving parts . . . minimum maintenance.

WRITE NOW for Descriptive Bulletins

FILTRATION DIVISION
U.S. HOFFMAN MACHINERY CORPORATION
214 LAMSON STREET, SYRACUSE 6, N. Y.
CANADIAN PLANT: CANADIAN HOFFMAN MACHINERY CO., LTD., NEWMARKET, ONT.

New Automatic Liquid Blender

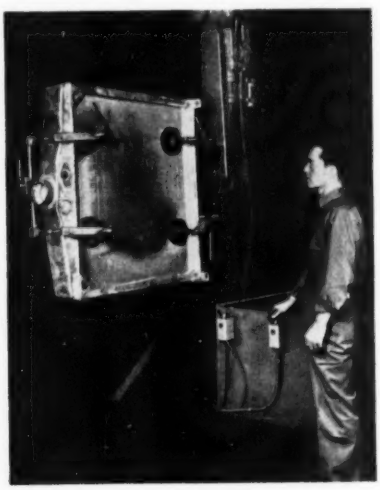
A new automatic proportioning system for blending two or more of a wide variety of liquids has been developed by Bowser, Inc.

No charts or calculations are necessary to set the blender for any combination of liquids. Simple controls on each meter permit instantaneous setting of ingredient proportions in increments to meet customers' exacting needs. Total throughout is recorded on a master counter and each ingredient is recorded separately on its own meter.

Failure of any ingredient supply automatically shuts off the entire system and, if the supply to any meter slows down for any reason, all meters synchronize automatically to the same rate of delivery.

Heavy Radiator Repair Aid

A new machine, named the "Hevi-Lift Positioner," has been placed on the market by the Krall-Bares Company to expedite radiator repairs on

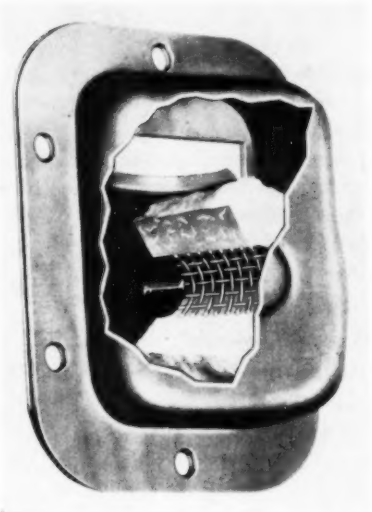


trucks, bulldozers, cranes and similar heavy industrial equipment.

This new machine gives one-man, touch-of-the-button ease to the handling and positioning of large radiators, where two or three men formerly were required. It is said to place the heaviest radiator in any position for soldering, testing, and repairing.

Transmission Oil Filter

A new type of oil filter for transmissions has been introduced by the



Fuller Manufacturing Company. A series of road tests show that the filter is effective in removing foreign materials detrimental to the gears and bearings of the unit.

New Literature

New Truarc Bulletins

A new series of engineering bulletins covering all types of Waldes truarc retaining rings, grouped by specific ring function, has been issued by Waldes Kohinoor, Inc.

Bulletin 6 covers a series of retaining rings specially developed to take up end-play and compensate for varying manufacturing tolerances and wear.

Bulletin 7 covers a series of external type rings applied radially without pliers. For positioning machine parts easily on shafts and especially where groove is inaccessible in axial direction.

Bulletin 8 covers a series of retaining rings that form artificial shoulders for positioning and retaining machine parts on shafts or in housings. Ring design secures circular deformation and freedom from permanent set.

Caviation Bulletin

A new 20-page bulletin, "Accelerated Caviatation Research," which describes cavitation-pitting tests has been made available by Allis-Chalmers Manufacturing Company.

The tests described were conducted to solve some of the phenomena of cavitation and to determine the relative resistance of pitting of recently developed materials and techniques for applying these materials.

Contents of the bulletin are based upon a paper presented at the annual meeting of the American Society of Mechanical Engineers on November 29, 1949 by William J. Rheingans, assistant manager of A-C hydraulic department. The paper was subsequently published in the July, 1950, ASME Transactions.

IMPARTIAL TESTS PROVE NEW MUFFLER SUPERIOR!

To help truck manufacturers and fleet operators satisfy public demand for noise abatement and to help reduce operator fatigue, Donaldson engineers developed this completely new exhaust silencing system. Lower noise level is obtained without power penalty! The back pressure of these Donaldson Mufflers falls well within the "acceptable range" permitted by engine manufacturers. Heavy-duty engines can now deliver their full rated power without objectionable exhaust noise.

In tests before impartial juries of highway officials, truck owners and truck manufacturers, the new Donaldson Mufflers were rated superior on overall performance. These tests proved that lower noise level and lower back pressure *can be combined* in a *fully-engineered* muffler. Furthermore this muffler is available at reasonable prices for popular models of heavy-duty trucks.

DESIGNED FOR HIGH OUTPUT ENGINES

Donaldson engineered exhaust systems have these additional advantages: Reduced valve pounding, improved volumetric efficiency of the engine, decreased fuel consumption, less smoke and fumes, lower muffler jacket temperatures and less cab-panel drumming and vibration. You get them all when you equip your engines with Donaldson Mufflers. *Made of aluminized steel throughout* to resist corrosion, Donaldson Mufflers last longer—100,000 miles of service is not unusual!

For results of official motor truck association muffler tests and complete information on Donaldson Muffler Systems, write us giving engine specifications. We can make immediate shipment for gasoline or Diesel engines in the 150 to 300 H.P. range.

Model M90010 vertical cab-mount muffler. *Dimensions, 9" diameter, 52" body length, 4 1/32" I.D. sleeves.*

Model M01201 oval-type for under-chassis installations

10" x 15" oval, 25" body length, 4 1/32" I.D. sleeves

Fully-guaranteed by the Donaldson Co., Inc. world's largest manufacturer of heavy duty air cleaners

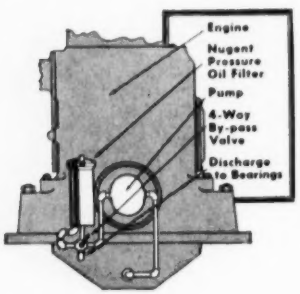
DONALDSON
Fully-Engineered
MUFFLERS

666 PELHAM BLVD., ST. PAUL 4, MINNESOTA

NUGENT large-capacity filters

...filter ALL THE OIL EVERY CYCLE BEFORE it goes to the bearings

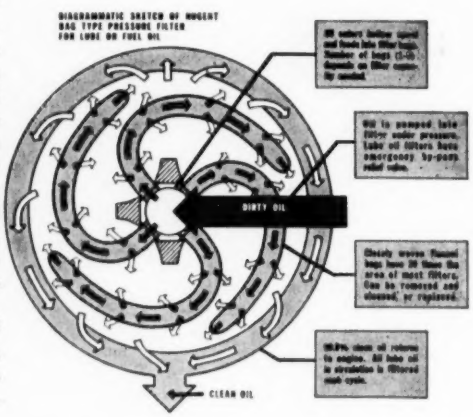
Nugent bag-type lube and fuel oil filters remove contaminants and dirt as soon as they get into the oil and none is by-passed to the bearings. IT'S THE OIL YOU BY-PASS THAT DOES THE DAMAGE. That the by-pass partial filter is outmoded and dangerous when used alone is proved by actual field tests, wherein bearing renewals showed a decided drop after the adoption of Nugent *full-flow filtering*.



Further, Nugent bag-type lube and fuel oil filters with expendable bags have 20 times more filtering area than other filters of comparable size. Using a Nugent filter, you'll be able to clean more oil per hour, with fewer changes of filter elements. This is particularly important in full-flow systems, where all the oil in circulation each cycle is being cleaned.

The illustration above shows a Nugent full-flow filtering system. Note that the oil is handled by the engine oil pump—no other pump is needed. Filtering systems of this kind are ready for power equipment of any size. Ask a Nugent engineer to give you full details.

The diagrammatic view below shows the tremendous filtering surface of a Nugent bag-type pressure filter. The bag, designed to be used and discarded, is made of a closely woven lintless material which removes particles as small as a few microns and delivers oil 99.8 per cent clean. This type of filter is ideal for filtering all the lube oil in circulation every cycle before the oil goes to the bearings, thereby removing the dirt as soon as it gets in the oil, and retarding the formation of sludge and acidity. The dirt-filled bags are easily removed without tools, and are inexpensively replaced.



There's a bulletin giving complete information on Nugent bag-type filters. Write for your copy today.

Wm. W. Nugent & Co., Inc.
417 N. Hermitage Ave. CHICAGO 22, ILLINOIS

OIL FILTERS, OILING AND FILTERING SYSTEMS, TELESCOPIC OILERS, OILING DEVICES, SIGHT FEED VALVES, FLOW INDICATORS

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Hydraulic Pullers and Jacks

Labor-saving applications of hydraulic pullers and jacks are discussed in a new 8-page bulletin, Hydraulic 51, issued by Templeton, Kenly and Co. The bulletin also introduces Simplex Re-Mo-Trol Hydraulic Pumps and Remote-controlled Rams. It illustrates how these units simplify rigging requirements and improve safety in numerous pulling, pushing and lifting operations, by means of "Center-Hole" tubular ram construction. Complete specifications are included.

Blower Bulletin

A bulletin on engineering layout, applications, design data and rating of Standaire blowers has been released by the Standard Stoker Company. The bulletin has tables for aiding the designer in choosing the unit required.

"Scotch" Tape Brochure

More than 30 uses for four "Scotch" brand electrical tapes for construction and maintenance work are described in a new 8-page brochure, put out by the Minnesota Mining and Manufacturing Company.

The brochure contains 33 photographs of applications such as the taping of lighting and communication systems, refrigeration equipment, relay cases, frequency changers, connectors, electric motors, bus bars, and others.

Operating Cost Bulletin

The first of a series of case histories on individual GMC trucks and GMC fleets, recorded to show how lower operating costs have been attained, is being distributed to truck operators by GMC dealers.

The first brochure goes into the operation of a GMC model HDC-745 diesel tractor, which hauls beverages over all types of roads with 3 to 6 per cent grades at speeds of 50 to 55 mph. The operation analysis brings out that the big diesel covered 128,648 miles in 11 months with average payload weight of 42,234 lb., getting 5½ miles per gal. of fuel oil and 1000 miles per quart of lubricating oil.

Bellows Bulletin

A new bulletin, containing information and descriptive material on Flexon Bellows is available from the Chicago Metal Hose Corp. The 18-page bulletin was recently prepared by the firm.

Among the subjects covered in the publication are a description of the manufacturing process used in making the bellows. Also included are design considerations, specifications, fittings for stainless steel and brass bellows. Typical bellows types and applications as well as a specification guide sheet are included.

Gear Hardening Booklet

Detailed operational information about the new radio-frequency gear-hardening machine, the Inductall, is presented in a new booklet available from Westinghouse Electric Corporation.

The Inductall's adaptability in handling spindle gears, spur gears, cluster gears and shafts for either through or contour hardening is explained with the help of diagrams and photographs.

Versatility of operation, the booklet points out, is achieved by use of a single-spindle type of feed that makes setups simple and fast.

Radiator Catalog

Young Radiator Company has just announced the completion of a new catalog No. 1651, covering its line of "Mono-Weld" radiators.

The four page piece shows the design features and accessories for both the one-piece and sectional-type cores. One-piece radiators are available in various sizes capable of dissipating from 70,000 to 800,000 Btu. per hour under standard conditions. The sectional-type core units are of larger size, ranging in capacity from 960,000 to 3,250,000 Btu. per hour.

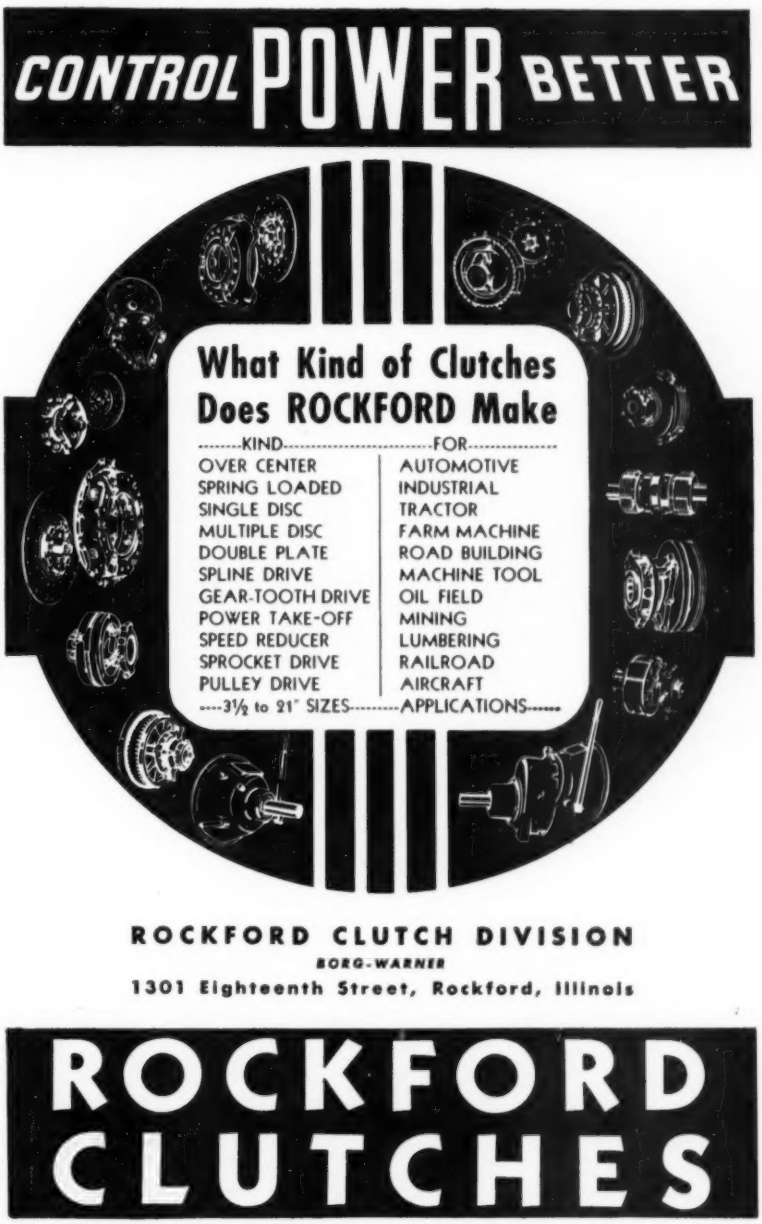
These Young-designed and produced radiators are said to be compact and sturdy for heavy duty gas, gasoline and diesel engine cooling. Core sizes range from 2½ feet to 10½ feet square.

Viscorator Instrument

A new catalog now ready for distribution by Fischer and Porter Company describes viscorator instruments that provide an instantaneous method for determining viscosity values for industrial processes. Featured is a new development in this field represented by the Auto-Sampling viscorator instrument which has a constant differential pressure regulator as an integral part of its design. This provides a constant meter sample flow rate (regardless of line fluctuations) in a simple self-contained unit.

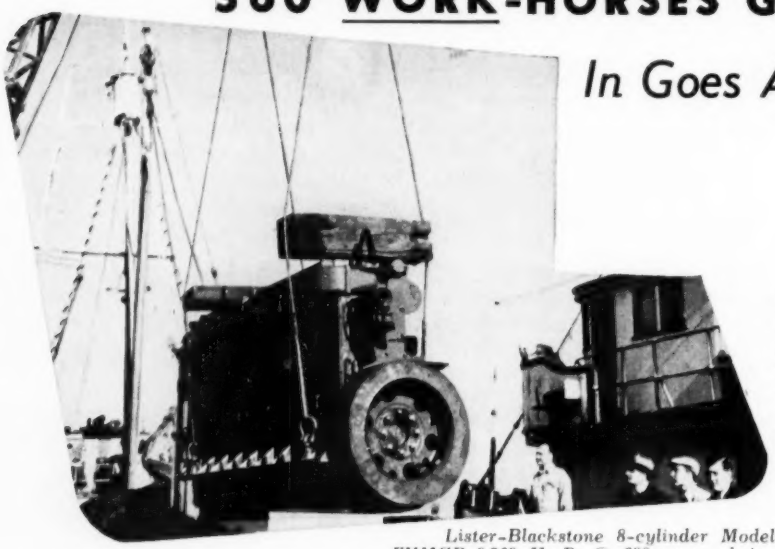
Heat Exchanger Bulletin

A new five page bulletin covering film type heat exchangers has been released by Henry Vogt Machine Company. The bulletin, H.E. 7, gives the principle of this type heat exchanger and many of its applications, including the cooling of jacket water for diesel engines.



360 WORK-HORSES GOING BELOW!

In Goes ANOTHER BIG



Lister-Blackstone 8-cylinder Model EVMGR-8,360 H. P. @ 600 r.p.m., being lowered onto the bedplates in still another engine room.

Atlantic-to-Pacific and Gulf-to-Great-Lakes, keen buyers, powering or repowering, are going for husky Lister-Blackstone diesels.

- ★ They *last*
- ★ Low prices
- ★ Ample spares *laid-down locally*
- ★ Low maintenance costs
- ★ Cost-to-coast *dockside service*
- ★ Good *delivery*

LISTER-BLACKSTONE, Inc.

Factory, Sales & Service Headquarters:
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Main Parts Warehouse:
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Boston • New York • Norfolk • New Orleans • Mobile
Tampa • Miami • Jacksonville • St. Louis • San Antonio
Dallas • Houston • Newton (Iowa) • Seattle • Long Beach (Cal.) • San Francisco • San Diego • Montreal
Toronto • Winnipeg • Vancouver

Write now for prices and specifications on low-priced Lister-Blackstones, propulsion, auxiliary and stationary, 3 H.P. to 480 H.P. State your requirements.

Zeolite Softener Bulletin

Cochrane Corporation has issued a new publication on hydrogen zeolite (cation exchange) softeners. This is a 16-page bulletin, giving a complete description of the process and the field of application, showing the relation of hydrogen zeolite softening to the sodium zeolite process. The bulletin is an explanation not only of the process, but of the zeolites themselves and the details of the equipment used in the process.

Ball Bearing Catalog

A new 12-page catalog on miniature ball bearings has been issued by Miniature Precision Bearings, Inc.

Containing complete specifications on more than 70 different types and sizes of miniature ball bearings, it includes details on typical applications of these bearings and photographs and diagrams of current installations in various fields.

Expansion-Joint Bulletin

Zallea Brothers has published a new 4-page bulletin describing their complete line of expansion joints.

Bulletin 351 gives sizes, dimensions, suggested applications and other technical data on a variety of joints from small flexible connectors for use on diesel exhaust lines to 30-ft. diameter self-equalizing joints for use in such applications as wind tunnels, etc.

Filter Booklet

An oil filter is not an oil refinery, according to a new 16 page informational booklet published by Caterpillar Tractor Co. Entitled "Don't Buy Trouble", it deals with oil filters, their purpose, their makeup, and the qualities to be looked for in a filter.

The booklet points out that there are two major aspects of a lubricating oil to be considered: one, the lubricating oil itself, which provides a film between the working parts, and two, the alloy oils, which hold the contaminants in suspension, thereby preventing them from working into the metal parts. It is these suspended contaminants which may then be filtered out.

Water Treatment Folder

A new 4-page folder on the use of organics in water treatment has been issued by the Power Chemicals Division, E. F. Drew & Company, Inc.

The folder describes the need for organics in altering the nature of sludge in order to make it non-adherent. It covers the theoretical and practical considerations involved in the use of organics, and describes and illustrates the manner in which they overcome the problems of sludge. The folder also contains micro-photographs of adherent sludge, showing results that can be expected.

Gauge Bulletin

A new 24-page bulletin on Water Level Gauges has just been published by The Bristol Company. The bulletin, No. L700, describes instruments for measuring and recording water depth in reservoirs, elevated tanks, rivers, lakes, irrigation systems, process storage tanks, forebay and tail races, flumes, and weirs.

Float, Pressure Bulb, Pressure, Counterpoise, Differential Pressure, and Air-Bubbler types of liquid level gauges for a variety of uses are described, including the measurement and automatic control of water and other liquids and solutions, whether flowing, turbulent, corrosive, under static pressure, covered with ice, or carrying solid matter. Applications of the instruments to chemical processing operations involving solutions, suspensions, and organic liquids are included.

Loading Resistor Bulletin

A new 8-page illustrated bulletin on loading resistors for testing diesel-electric locomotive power plants is now available from the General Electric Company.

The bulletin, GEA-5515, outlines all the advantages of the loading resistor, its uses, ratings and dimensions and operating instructions. A complete description of the power connections, loading characteristics, instruments, blower unit, resistors and switches is also included.

Texaco Combustion Process

(*Continued from page 35*)

types of engines. The otto-cycle, as may be seen, operates at high output and high fuel consumption, and is limited on the lean end by misfiring. The diesel engine, on the other hand, operates at low fuel consumption but also in a lower range of output, never attaining the high output of an otto-cycle engine. The TCP curve covers the range of both the other cycles and combines in a single operation the two best features of otto and diesel engines, namely, the high part-load fuel economy of the diesel and the high full-load power of the otto-cycle engine.

Relative Efficiency—The ratio of the actual indicated thermal efficiency of an engine to the efficiency of the ideal process upon which the design of the engine is based may be called the relative efficiency. Relative efficiency is a measure of the perfection of the design or of the state of development of the actual engine.

As might be expected from its relative newness, the TCP engine is at a lower state of development than either of the other engines. It seems reasonable to assume that additional development work can bring TCP to about the same level of relative efficiency that the diesel and otto-cycle engines have attained. However, the attractiveness of TCP does not appear to depend on degree of development, but rather on the characteristics already at hand, namely, that it combines in a single operation the best performance features of otto- and diesel-cycle engines without introducing the fuel quality requirements of either.

Honan-Crane Cuts Diesel Overhaul 50%
A report from Lindsborg, Kansas Municipal Power Station says—
"Since installation of Honan-Crane purifiers, improvement in the condition of oil and in engine cleanliness has been so marked that city engineers plan to pull pistons only once every two years instead of every year as has been their custom."
ONLY A HONAN-CRANE OIL PURIFIER GIVES YOU THIS KIND OF PROTECTION
Write today for complete information
HONAN-CRANE CORPORATION
305 WABASH AVENUE, LEBANON, INDIANA
A SUBSIDIARY OF
HOUDAILLE-HERSHEY CORP.
Honan-Crane purifier using Cranite (specially processed Fuller's earth) continuously serves the 1200 HP. Model 33FD Fairbanks, Morse dual fuel unit at Lindsborg, Kansas Municipal Power Station

Field Notes

New I-H Training Program

Latest service and maintenance information on International Harvester industrial power products will be brought to the company's district office and distributor service personnel by two mobile training units that start a nation-wide tour this month.

Instructors will present the International product servicing story with the aid of charts, slide films, and movie films. Sets of special tools and equipment will be displayed on the walls of each trailer and usage will be detailed during the discussion period.

Presentation will be highlighted by the use of cross sectioned working models of various International crawler tractor components including the diesel engines. In addition, there is a complete fuel injection system laboratory.

International Harvester distributors plan to invite interested contractors, operators and service organizations when the training program is presented at their home office. Trucks will operate under the supervision of I-H district office personnel in each territory.

Diesel Shops for N. Y. Central

Large shops for the inspection and repair of diesel-electric locomotives will be constructed by the New York Central at East Syracuse and East Buffalo. Work on the shops, costing several million dollars, is expected to be started late this summer.

The East Syracuse shop will have three through tracks with servicing platforms, each capable of accommodating a four-unit locomotive, two drop pits, and one release track with crane service. A washing machine for locomotives also will be installed beside an outside track. It is expected that this diesel shop ultimately will maintain, between general overhaulings, approximately 195 road freight units, 46 road switching locomotives and 65 yard switchers.

The new East Buffalo shop will be equipped with a drop pit under four tracks, a drop table for changing engine trucks, cranes and other equipment. Some 145 yard switchers and road switchers will be maintained there eventually. These will be diesels assigned to Buffalo, Black Rock, Suspension Bridge, Batavia and Rochester.

ASME Meeting, June 25-29

Dallas, Texas, will be the scene of the 23rd Annual Conference and Exhibit of the Oil and Gas Power Division, ASME. The meeting will take place the week of June 25th at the Baker Hotel.

An extremely interesting program has been planned with papers discussing supercharging, crankcase explosions, gas engine development, gas generators, exhaust snubbers for gas engines, and performance and operation of water cooling equipment.

A high point of the program will be two Panel Discussions. In the first of these, operators will have an opportunity to air their problems with respect to engine operation and maintenance. In the subsequent Panel, manufacturers will give their viewpoints. This should be an extremely interesting and constructive feature.

As in the past, there will be a series of Special Lectures, the subject on this occasion being "Governors". Two eminent authorities will undertake this phase of the program. The lectures will take place on Tuesday, June 26, and will be incorporated as part of the general technical program.

A particularly interesting inspection trip has been arranged. The Halliburton Cement Plant in Corpus Christi, Texas, where cement is made from oyster shells with the help of some 3000 diesel horsepower, will be one stop.

The second trip will be to the largest internal combustion plant in the world, Alcoa's Point Comfort electrolytic ore reduction plant, where 120 Nordberg radial gas engines each rated 1600 hp. produce the power necessary for primary aluminum production.

In view of the distances involved, arrangements with a scheduled airline are being made for transportation. A trip of this interest is a rare opportunity and well worth the cost involved. In addition, local (to Dallas) trips to inspect pipeline facilities are also being arranged.

Honeywell to Work with Westinghouse

Minneapolis-Honeywell Regulator Company announces completion of an arrangement to perform consulting services to the Atomic Power Division of Westinghouse Electric Corporation, Pittsburgh, Pa.

Under the agreement, Honeywell engineers will act as consultants in valve problems arising in the Westinghouse program. Specially designed valves, never before used in industrial or marine services, will be employed.

GM Parts Warehouse

Increase in the application of diesel locomotives in the southwestern part of the United States has necessitated the establishment of a new parts warehouse by General Motors in Ft. Worth, Texas. The new supply center began operations May 1. The operation occupies 10,000-sq. ft. of leased space in a new warehouse.

Obituary

Maxim Silencer, V-President Dies

Frank L. Orr, vice-president and sales manager for the Maxim Silencer Company died in Washington, D. C. on April 15th, while on a business trip.

Mr. Orr was born December 15th, 1894 in Saunderstown, Rhode Island. In World War I, he served as an ensign in the destroyer service. He was a mining engineer in Colorado for a time after the war. Later, he was with the Diesel Engine Division of Fairbanks, Morse & Company and in November 1930 joined the Maxim Silencer Company.

Mr. Orr was a Mason and a member of the American Society of Naval Engineers and the Society of Naval Architects and Marine Engineers.

He leaves his wife, Mrs. Edith Pringle Orr, and a daughter, Miss Marion Orr of New York City.

Diesel Engines for Aircraft

Taylorcraft, Inc. has been granted exclusive rights by Diesel Power, Inc. to install and use in light airplanes diesel engines up to 500-hp., embodying the patent inventions of Diesel Power, Inc.

Diesel Power claims that an airplane so powered will have the advantages of greater power, less and cheaper fuel consumption, freedom from smoke, quicker take-off, 40 per cent higher flying range and less danger of fire in case of crashing.

Taylorcraft is the first in the airplane industry to secure such a license. Development work will begin immediately at the Taylorcraft plant, Conway, Pa.

here's an "EYE"

that never leaves the gauges

Like a hawk . . . every second, day and night . . . the PENN Safety Control "watches" the gauges so that overheated cooling water or oil pressure failure can't cause damage to your engines!

At the first sign of engine overheating or lubricating oil pressure failure, the PENN control *automatically* gives the alarm . . . rings a bell, flashes a light or shuts off the engine. Then you can investigate and correct the fault before damage occurs.

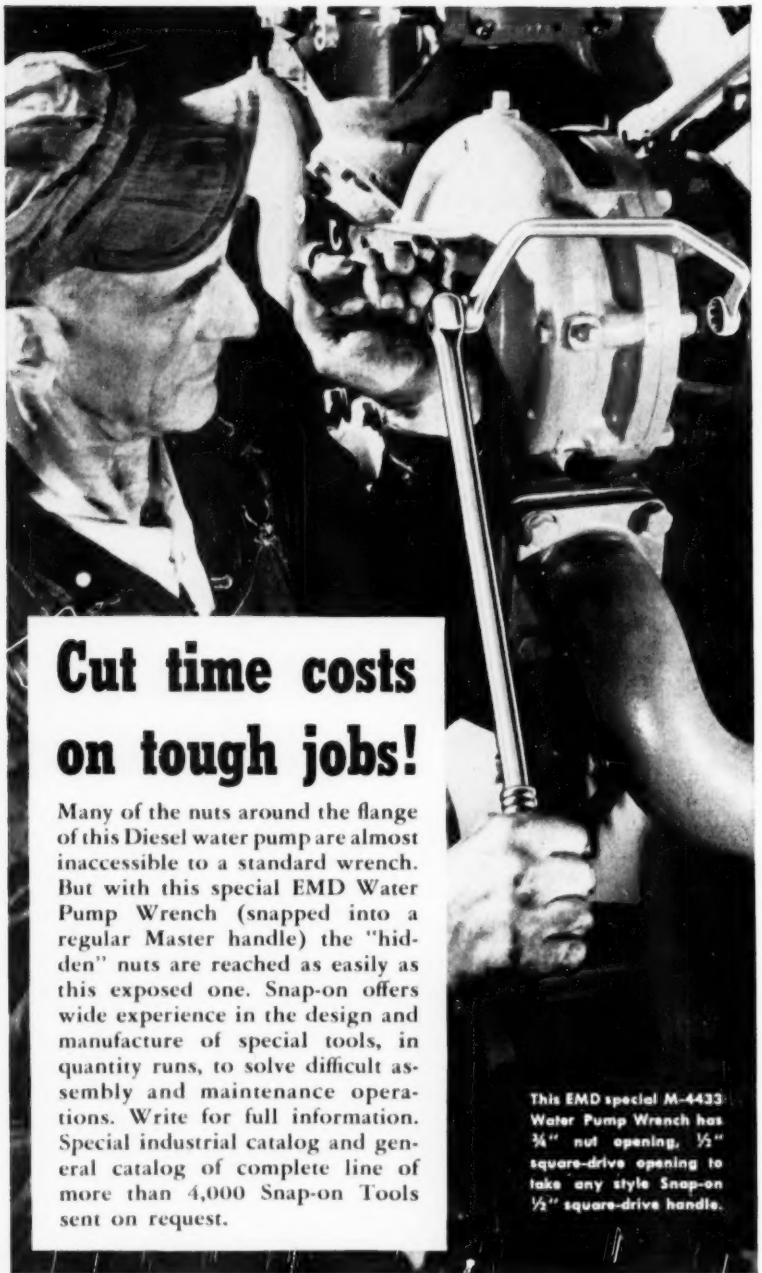
Learn more about this *low-cost, positive protection.* A few dollars invested in PENN Safety Controls will give you thousands of dollars worth of dependable protection for your engines. Write for Bulletin E-100 which fully describes the three basic models . . . oil pressure only . . . water temperature only . . . combination pressure and temperature. **Penn Electric Switch Co., Goshen, Ind.** Export Division: 13 E. 40th St., New York 16, U. S. A. In Canada: Penn Controls, Ltd., Toronto, Ont.

PENN

AUTOMATIC CONTROLS

FOR HEATING, REFRIGERATION, AIR CONDITIONING, PUMPS, AIR COMPRESSORS, ENGINES, GAS RANGES

Snap-on* Tools



Cut time costs on tough jobs!

Many of the nuts around the flange of this Diesel water pump are almost inaccessible to a standard wrench. But with this special EMD Water Pump Wrench (snapped into a regular Master handle) the "hidden" nuts are reached as easily as this exposed one. Snap-on offers wide experience in the design and manufacture of special tools, in quantity runs, to solve difficult assembly and maintenance operations. Write for full information. Special industrial catalog and general catalog of complete line of more than 4,000 Snap-on Tools sent on request.

This EMD special M-4433 Water Pump Wrench has ¾" nut opening, ½" square-drive opening to take any style Snap-on ½" square-drive handle.

*Snap-on is the trademark of Snap-on Tools Corporation.

SNAP-ON TOOLS CORPORATION
8064-E 28th Avenue
Kenosha, Wisconsin

Diesel Training in Newfoundland

The cut-away diesel which was lately forwarded for display and instructional purposes from the Caterpillar Tractor Company to the Newfoundland Tractor and Equipment Company in St. John's, has now been placed in the Vocational Institute. Mr. Bliss, sales manager of the local company, recently paid a visit to the Institute and gave a very interesting and informative talk to the students on the construction, merits and work capacity of the diesel and answered the many questions concerning it.

London Exhibition

The largest display of engineering manufactures in the world will once again be on view at the Engineering, Marine and Welding Exhibition which will be held in London from August 30 to September 13, 1951.

The exhibition has been held in alternate years since 1906, except for the interruptions caused by the two world wars. This year, when hundreds of thousands of overseas visitors will be in the U. K. for the Festival of Britain, steps are being taken to meet the needs of a record number of overseas visitors to the exhibition. It will be the center where buyers can make easy and direct contact with manufacturers of all types of engineering equipment and examine on the spot any of the thousands of exhibits collected together under one roof.

The chief sponsor of the exhibition, the British Engineers' Association, 32 Victoria St., London, S. W. I., England, is at all times pleased to assist overseas buyers of engineering equipment in contacting suitable U. K. manufacturers.

New A-C Branch Office

A new branch office has been opened by Allis-Chalmers' General Machinery Division in Peoria, Illinois.

The new manager is Stanley E. Bovim. He has been employed by the company since 1923, working in the electrical maintenance and Texrope drive departments. Since 1933 he had been with the Chicago district office as a sales representative.

New Burgess-Manning Branch

The Burgess-Manning Company, manufacturers of industrial noise abating equipment, recently opened engineering and sales facilities in Dallas to serve petroleum and chemical industries.

Over-all charge of manufacturing facilities, sales office and research laboratories is in the hands of R. L. Leadbetter, vice president of the concern. S. G. Paddock is manager of sales and A. P. Gallagher is assistant engineer.

Cutback Due to Material Shortage

A critical shortage of materials will not permit full production at Caterpillar Tractor Company during the vacation period, August 6-19. No prime products will be assembled during the two weeks. The company does plan to manufacture parts, however. It also will ship out machines urgently needed by the military and essential civilian users.

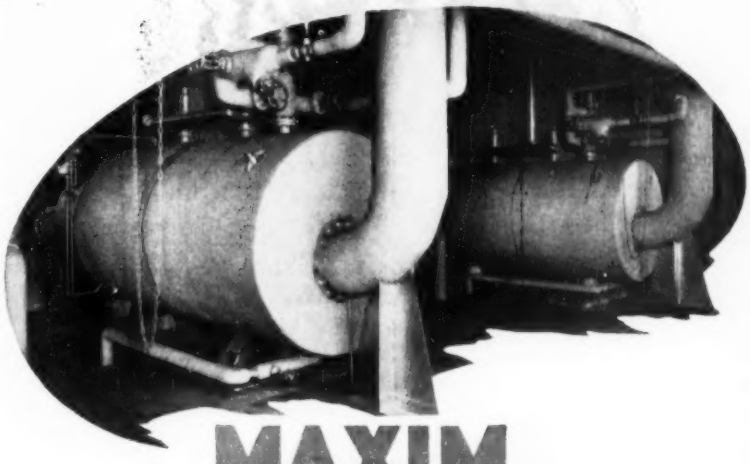
Gas Turbine Generator

Westinghouse Electric Corporation has sold the largest gas turbine-generator yet ordered for the commercial generation of electric power to the Bartlesville area of the Public Service Company of Oklahoma. Natural gas from the Oklahoma fields will provide the heat energy for the new 15,000-kw. machine. It is scheduled for delivery in about three years.

The 700,000-lb. turbo-generator installation will consist of the gas turbine as the primary source of power, driving a hydrogen-cooled generator. The gas turbine will comprise high and low pressure turbines driving high and low pressure compressors, respectively, with the high-pressure turbine also connected to drive the generator.

The turbines will operate at 1350° F—300° higher than even the hottest steam temperatures in use today in electric generating stations, and about twice as high as the average steam generatng plant. Speed will be 3600-rpm. At full load the compressors will draw in 7½ tons of air every minute.

IS WASTE HEAT WASTING YOUR MONEY?



MAXIM

HEAT RECOVERY SILENCERS CONVERT WASTE EXHAUST HEAT TO USABLE STEAM or HOT WATER

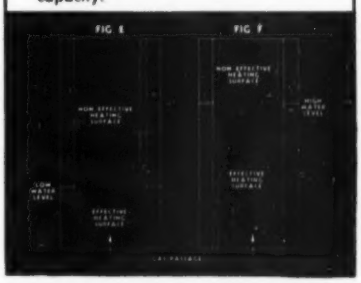
A big Los Angeles Sewage Disposal Plant found that Maxim Heat Recovery Silencers provided all the steam necessary for plant heating as well as heating the sludge — *and from exhaust heat that would otherwise have been wasted.*

Perhaps your own operating expense picture can be improved by this simple and effective way to provide extra steam or hot water for heating or processing operations while at the same time effectively silencing exhaust noise. Our engineering department will be glad to make recommendations.

Automatic Controls

In figure E water is low and there is less *effective heating surface* (heating surface in contact with water), hence lower steaming rate.

In figure F water is high and gives greater effective heating surface — higher steaming rate. Steam pressure regulated valves control the amount of water to produce desired steam capacity.



Consult MAXIM

THE MAXIM SILENCER COMPANY 93 HOMESTEAD AVE., HARTFORD 1, CONNECTICUT

Gentlemen: Please send me your Bulletin on Heat Recovery Silencers

NAME _____

COMPANY _____

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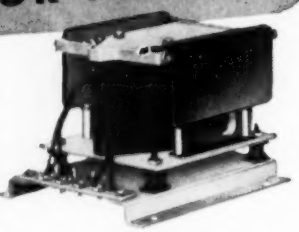
Burlington
GENERATOR VOLTAGE REGULATOR TYPE WA



Designed for use in regulating the voltage of A.C. generators in Stationary, Mobile or Marine installations.

Direct rheostatic action provides a simple, effective and automatic means of regulating voltage by preforming the function of an automatic field rheostat.

Rating of rheostatic element is 2 amperes maximum exciter shunt field current at full load and power factor. Maximum sigma watts is 50 watts.

FEATURES

- Direct Acting
- Fast Response
- Automatic Control
- Small, Compact, Self Contained
- Rugged Construction
- Rheostatic Action
- Inexpensive

Inquiries for complete information and engineering services solicited.

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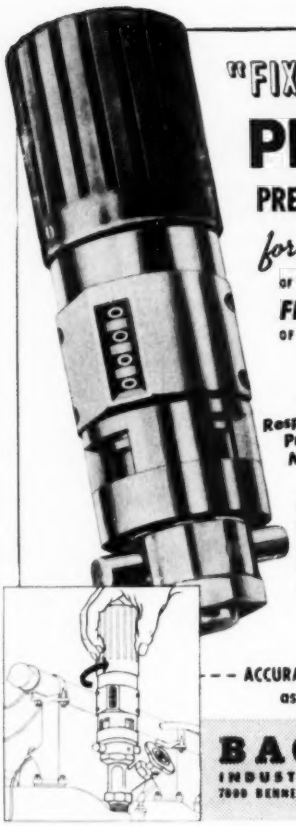
BURLINGTON, IOWA



"FIXED-READING"
PREMAX
PRESSURE INDICATOR
for DIRECT-READING
of COMPRESSION AND
FIRING PRESSURES
OF EVERY TYPE OF DIESEL ENGINE

ONE OF THE FEATURES
Responsible for its Overwhelming Preference by Leading Diesel Manufacturers and Operators

Maintenance requirements reduced to minimum. Needs no field adjustments, no lubrication. Calibrating means built-in—making possible quick check of calibration.

For other features, write for Bulletin 294

ACCURATE PRESSURE READINGS as high as 1700 P.S.I.

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ASTM Meeting

Seven technical symposiums and many other technical papers on a wide range of subjects in the field of engineering materials are on the program of the 54th Annual Meeting of the American Society for Testing Materials at Chalfonte-Haddon Hall, Atlantic City, June 18 to 22, inclusive.

An important feature of the program will also be the Edgar Marburg Lecture to be given by Frank L. LaQue, international authority on corrosion, and in charge of the Corrosion Engineering Section, International Nickel Co., who will discuss corrosion testing.

Beginning Sunday, June 17, and extending through Friday, June 22, there will be an estimated 450 meetings of the various ASTM technical committees.

The purpose of the symposiums as developed by ASTM is to present the latest thoughts and practices on the respective subjects through a series of technical papers by leading authorities, and to provide an opportunity for discussion by other interested parties.

IDECO Sells Supply Stores

International Derrick & Equipment Company announces the sale of its chain of fifteen supply stores to the H. K. Porter Company of Pittsburgh.

This sale was a result of the company's decision to concentrate solely on development and manufacture.

HILCO LUBE AND FUEL OIL PURIFICATION FOR DIESEL AND GAS ENGINES . . .

PURIFIERS · FILTERS · RECLAIMERS · CONDITIONERS
THERE'S A HILCO FOR EVERY LUBRICATION AND FUEL OIL FILTERING PROBLEM . . .
YOU WANT CLEAN OIL AND CLEAN ENGINES TO SAVE EQUIPMENT - OIL AND MONEY -
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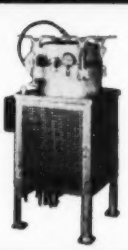
★ WRITE FOR FREE LITERATURE - NO OBLIGATION



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IN CANADA — UPTON-BRADEEN-JAMES, LTD. — 990 BAY STREET, TORONTO, 3464 PARK AVE., MONTREAL

Diesel-Powered Pump

Recent completion of a 600-ft. water well and pumping installation will assure Kerrville, Texas, population 11,000, a normal water supply through any emergency. The well is pumped from the 120-ft. level through a 16-in. casing.

Electric power drives a heavy-duty pump delivering 1000-gpm. The pump is also equipped with a standby 180-hp. International UD-24 diesel engine which can handle the entire pumping job during electric power failure of any duration.

The new well alone can supply ample water for the city's normal daily requirement of 700,000 gal. In addition, several original wells can boost the total to 3,000,000 gal. per day during the dry summer months.

Standard Stoker Changes Name

The Standard Stoker Company, Inc. has changed its corporate name to Read Standard Corporation. This is a change in name only. There has been no change in ownership, management or personnel.

The company has diversified its activities in the past several years. Present products include stokers for railroad and industrial use, bakery machinery ovens, chemical processing equipment and axial flow positive pressure blowers.

Cummins Merger

Merger of two wholly owned Cummins sales and service organizations with Cummins Diesel Sales Corporation has been announced.

William B. Lawrence, formerly regional manager for the Rocky Mountain region, has been named general manager of the Sales Corporation, which has headquarters at Columbus, Indiana.

Subsidiaries affected by the merger are Cummins Diesel Sales Corp. of Illinois, and Cummins Diesel Sales and Service of New York, Inc. These two organizations are now identified with Cummins Diesel Sales Corp., which also includes dealerships with operating headquarters at St. Paul, Omaha, Indianapolis and Memphis. The six dealerships are now under Lawrence's direct supervision, although each continues to function as an independent unit in the selling and servicing operations in their individual territories.

ABOE Exhibits

An invitation to Americans attending the Festival of Britain to visit any or all of the exhibits of ABOE, Ltd., the London Company, has been extended. The Festival extends from early May through September of this year and is an exhibition of British design, craftmanship and cultural activities.

The exhibitions at which ABOE diesel engines will be displayed are: Industrial Power Exhibition, Kelvin Hall, Glasgow, Scotland, May 28 to August 23; British Industries Fair, at London and Birmingham, April 30 to May 11; and the Engineering and Marine Ex-

BACHARACH NOZZLE TESTER for LARGE SIZE DIESEL NOZZLES

Check These Features

- Test Pump 1800 cu/mm capacity; ported design. Leak-proof—plunger is chrome steel, hardened, ground and lapped into pump body.
- Nozzle-holding Fixture has spring clamps that accommodate nozzles of different shank diameters. Nozzle is simply "snapped" into position between the clamps.
- Fuel Supply Reservoir (2.5 pint capacity) of durable, transparent plastic; fuel level can be easily observed.
- Micronic-type Filter is noted for its superior cleaning efficiency; is easily replaceable.

Get full particulars — Write for Leaflet 628

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Attention: Maintenance Superintendents and Owners of Diesel-Powered Equipment

HANCOCK

RECONDITIONED UNIT INJECTORS FOR GM 71 AND 567 ENGINES ARE AVAILABLE FROM OUR STOCK ON AN EXCHANGE BASIS, AS ARE GM 71 FUEL TRANSFER PUMPS.

HANCOCK Service Gives You:

- One day delivery from our stock.
- The service of a modern injector laboratory completely tooled with the latest grinding, lapping and gaging equipment to handle all necessary work.
- A flat price for injector exchange regardless of condition of the plunger and bushing.
- A completely rebuilt unit injector that has been thoroughly tested after an actual run-in test.
- Any output of 71 engine injector available — 60 mm, 70 mm, 80 mm and 90 mm.
- An unconditional guarantee of satisfaction.

We will buy used General Motors and Caterpillar injection equipment.

Dealers write for our attractive proposition

DIESEL SERVICE DIVISION

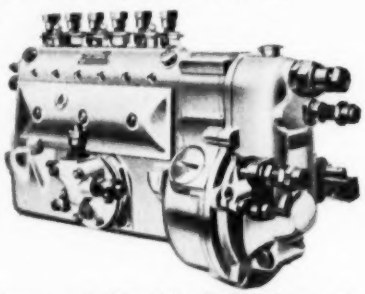
HANCOCK MACHINE COMPANY, INC.

300 WALNUT STREET FINDLAY, OHIO

Transport operators all over the world have learnt to trust this sign.

In any language the letters on the C.A.V. sign stand for first-rate service facilities, maintained by highly-trained craftsmen, using special precision equipment.

Wherever vehicles fitted with C.A.V. Fuel Injection Equipment are exported — whether to Trondheim, Santiago, Hong-Kong or Sydney — there's a service agent or depot to give it the specialist attention needed for such high-precision equipment.



Fuel Injection and Electrical Equipment

Service Depots throughout the World

C.A.V. DIVISION OF LUCAS ELECTRICAL SERVICES INC., NEW YORK 19, N.Y. Sales Office: 14820 DETROIT AVE., CLEVELAND 7, OHIO

174-344B

hibition, Olympia, London. August 30 to September 13.

Those desiring a specially conducted tour of the company's factories should write to Bosworth Monck, executive vice president of the American Company, ABOE, Inc., New York City.

A.P.I. Meeting

Hundreds of technical experts and safety men from all sections of the country were in Tulsa the week of April 29 for the 16th midyear meeting of the Division of Refining of the American Petroleum Institute.

One of the key papers presented discussed the development of high compression engines. This was presented by C. L. McCuen, of General Motors, Detroit. Another paper, by Dr. Frances W. Lamb and Leonard M. Niebylski of Ethyl Corp., Detroit, represented the fruits of three years of study on the problem of engine deposits and their formation in automobile motors.

Subjects covered included analytical research, refinery waste water, corrosion, electrical equipment, training of technical men, fuel utilization and liquefied petroleum gas as a motor.

W. L. Stewart, Jr., of Union Oil of California; and Stewart Harral, of the University of Oklahoma addressed the traditional open dinner session on May 2nd.

Organizational News

Robert H. Morse, Jr. Appointed

Robert H. Morse, Jr. has been appointed general manager of Canadian Locomotive Company. He has been

president of the firm, as well as president of Fairbanks, Morse & Co. of Chicago, and chairman of Canadian Fairbanks, Morse & Co. Ltd. of Montreal.

J. J. Jarrell, vice president and former general manager of Canadian Locomotive Co., was made vice president in charge of manufacturing.

Alcoa Elections

Roy A. Hunt, president of Aluminum Company of America since 1928, was named chairman of the executive committee and I. W. Wilson, senior vice president, was made president, at a recently held board of directors' meeting. Arthur V. Davis continues as chairman of the board. Leon E. Hickman was elected vice president and general counsel of the company.

TAC does what no other tool can do!

AT LAST! AN OPEN-END RATCHET WRENCH — the world's first true *universal* wrench. A patented design for connections on tubing, rods, piping, conduit, studs, etc. Sixty-four socket sizes from ⅜" to 4". Smallest effective ratcheting arc yet — 5° to 7½°. TAC will also do every job any ordinary ratchet wrench will do: one TAC set replaces literally dozens of single-purpose hand tools.

makers of advanced tools for industry

TAC

TAC is the registered trademark of

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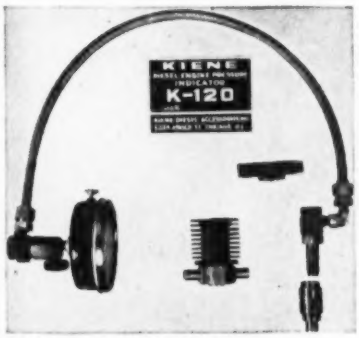
7112 South Victoria • 10321 Anza Ave. • Los Angeles, Calif.

KIENE MODEL K-120 UNIVERSAL PEAK PRESSURE INDICATOR



Model K-120 with cooler body and nozzle dummy.

For

Testing Firing and Compression Pressures on all Models of Diesel and Gas Engines.

Dependable — Easy to Use — Rugged. May be Used With or Without Flexible Tube.

MODEL K-120 Indicator has but one moving-part—nothing to wear or get out of adjustment.

VALVE—Gas trap type with diaphragm type check valve having adjustable lift. Stainless steel valve and seat.

No springs—No pistons—no complicated adjustments — No temperature corrections — no pressure loss in check valve.

GAGE READS TRUE PRESSURE—MAY BE RECALIBRATED ON ANY GAGE TESTER

Check readings can be made over and over again by releasing indicated pressures with bleeder valve.

GAGE—Hydraulic 3½ inch dead weight tested in suitable range to specification requirements.

ADAPTORS available for most models of engines manufactured in U.S.A. Other models made to order at reasonable prices.

DESCRIPTIVE BULLETINS AND PRICES FURNISHED ON REQUEST

Manufactured under patents No. 2280411, No. 2328325, others pending

KIENE DIESEL ACCESSORIES, INC.

10352 PACIFIC AVE., FRANKLIN PARK, ILLINOIS

Specify

COLUMBIA

A. C. and D. C. GENERATORS

- For Coupled Service
- For Belt Drive
- Single or Two Bearing

Columbia, with its years of experience, brings to generator set assemblers a wide line of performance proved, sturdily built, A. C. and D. C. Generators.

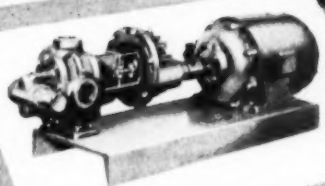
AC Generators: 6¼ to 1000 KVA
DC Generators and Exciters: 2 to 300 KW

•

Write for information. Our Engineers will be glad to review your requirements.

COLUMBIA ELECTRIC MFG. CO.
4537 Hamilton Ave. **Cleveland 14, Ohio**

EFFICIENCY + PLUS



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FOR GENERAL PURPOSE PUMPING

Efficient, dependable pumps noted for endurance and high records of performance. They serve tank trucks, refineries, process plants and general industries — they will do an equally productive job for you. Series 3600 pumps feature hardened helical pumping gears, high-lead bronze bearings, split packing gland, adjustable relief valve. Standard or special fitted models; pressures to 60 P.S.I. — capacities 40 to 300 G.P.M.

Send for Booklet "HOW TO SOLVE PUMPING PROBLEMS"

ROPER *Rotary Pumps*

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GEO. D. ROPER CORP.
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ROCKFORD, ILL.

Aboard N. Y. City Ferry Boats

Reiner DIESEL GENERATORS

The Reiner 10-kw. diesel generator above is one of several used on N.Y.C. ferry boats. It's the choice because it easily meets the rigid requirements set up for this service.

Whatever your power needs — generators, pumps or compressors — diesel, gas or gasoline driven — Reiner can meet them from a wide range of standard and custom built models. Write for details.

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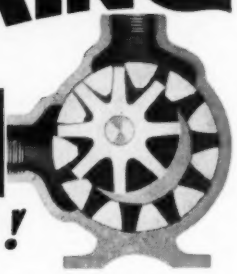
LIKE VIKING WARRIORS OF OLD

VIKING ROTARY PUMPS are RUGGED!



Just as Viking means rugged warriors, so does Viking stand for rotary pumps that are rugged. Designed and built for service, Viking pumps have proved dependable and long-wearing.

Note the simple "gear-within-a-gear" construction, with only two rugged moving parts and no small, intricate pieces to wear and get out of adjustment. You'll then know why Vikings are so famous for long, dependable service.

For information on Viking pumps, write today for free Bulletin 51SD.

See Our Catalog in SWEETS

Viking PUMP COMPANY
Cedar Falls, Iowa

Ampco Transfer

Louis C. Begg has been named district manager of the newly established Buffalo sales division of Ampco Metal, Inc. He was transferred from the main office in Milwaukee where he has, for the past three years, served as special sales engineer.

Independent Pneumatic Election

Robert G. Faverty, managing director of Armstrong Whitworth and Co., Pneumatic Tools, Ltd., Thor subsidiary in Newcastle-On-Tyne, England, was elected a vice-president of Independent Pneumatic Tool Company recently.

Mr. Faverty, who assumed his present position at the head of the England subsidiary in February, was formerly manager of the Thor Chicago and Detroit branches. He has been in the company's sales division since 1929, when he started as a service engineer in the Chicago territory.

Enterprise Appointment

Henry D. Bahr has been appointed manager of the Service Department of Enterprise Engine & Machinery Company.

Bahr was previously the company's Far Eastern service representative in the Philippines.

New American Brake Shoe Vice President

Raymond H. Schaefer was recently elected a vice president of American Brake Shoe Company. Formerly director of research and development, he will continue in charge of the research activities of the company, his headquarters remaining at Mahwah, New Jersey.

Mr. Schaefer is a native of Lynn, Mass., and a graduate of Carnegie Institute of Technology. He joined American Brake Shoe Co. in 1940.

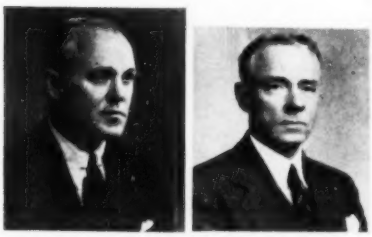
Borg-Warner Appointment

Carl R. Brick has been appointed as assistant to Roy C. Ingersoll, president of Borg-Warner Corporation.

He has served for several years as the corporation's Industrial Training Consultant, and was formerly vice president in charge of Industrial Relations with Dealers' Transport Company. He is a graduate of Kenyon College.

De Laval Elects Officers

The De Laval Separator Company recently elected officers.



C. B. Schmidt, left, has been elected president. He has been associated with the company for the past 29 years, serving for 14 years as general manager of the western division. In 1945 he was recalled to New York to assume the office of vice president. He is a graduate of the Carnegie Institute of Technology.

George W. Smith, right, is the new chairman of the board of directors. He is also president of the De Laval Steam Turbine Company of Trenton.

Re-elected were E. Gray Merrill, vice president, manufacturing; James E. Austin, secretary and assistant to the president; and T. H. Walworth, treasurer.

George E. Stoddard, who retires as president and director, will continue to serve in an executive advisory capacity.

Hunt-Spiller Chief Chemist

Stella R. Ellis has been named chief chemist for Hunt-Spiller Manufacturing Corporation. A graduate of Boston University, she joined the metallurgical department of the foundry in 1943 as a laboratory technician.

Nordberg Appointment

Appointment of Paul S. Shirley as chief development engineer, Heavy Machinery Division, was recently announced by the Nordberg Manufacturing Company.

Mr. Shirley is a graduate of Ohio State University, with a degree in mechanical engineering. He was in charge of all experimental work and testing of diesel and gas engines of National Supply Company, and was chief research engineer at Baldwin-Lima-Hamilton, before joining the Nordberg Co. in 1951.

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WHEN the job of re-metaling bearings comes up on your maintenance schedule call Sigurd Golten, who will rebabbit your diesel engine bearings in a fraction of the time usually required.

Through the use of specialized centrifugal rebabbiting apparatus, the Sigurd Golten Machine Corporation can return bearings to service quickly and in "good as new" condition.

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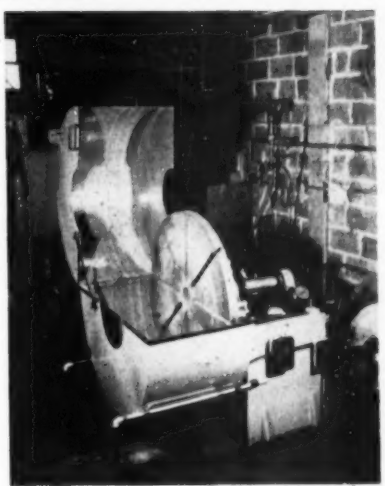

Shown above is part of our specialized rebabbiting machinery in regular operation. The centrifugal table is in vertical, or operating position. During the cast, the safety cover is dropped over the spinning table. Carefully engineered equipment and highly skilled operating personnel assure perfect rebabbiting by the centrifugal method.

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Diesel Bulletins 1020 & 50A furnish complete information.

See our Catalog in Sweet's File for Product Designers.

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Johns-Manville Appointments

C. A. de Vyver has been appointed manager for Insulations of Johns-Manville. He was formerly assistant manager of insulations. He is a graduate of Cooper Union, New York City, with a B. S. degree in chemical engineering. He joined the company in 1929.

Duane D. Crews has been appointed manager of construction of the J-M Industrial Products Division. He joined the company in 1935 as construction manager for one of its subsidiaries in Syracuse.

Worthington Supervisor

Robert C. Tierney, formerly coordinator in the vertical turbine pump division of Worthington Pump and Machinery Corporation at Harrison, N. J., will be in charge of the new vertical turbine pump plant at Succasunna, New Jersey, when it is completed.

After attending Newark Technical School, Mr. Tierney joined the corporation in 1935 to do general shop work. A year later he joined the engineering division at Harrison, and in 1948 became co-ordinator in the vertical pump division.

Cummins Changes

Charles C. Sons, formerly a field engineer on the Minnesota iron range, has been appointed acting eastern service manager with headquarters in Columbus of Cummins Factory Service Organization. He will work directly under the supervision of the general service manager, and will handle the service problems of dealers in the Eastern, Southeastern, Great Lakes and Central regions.

Dillard B. Davis, formerly eastern service manager, now is regional service representative in the central region, having headquarters in Chicago. He replaces Lloyd Kerber, who recently resigned to accept the position of general service manager for Cummins Diesel Sales Corporation of Missouri, at St. Louis.

(Organizational News Continued on Page 80)

FREE -

71 ways to save on maintenance cleaning

HERE'S a 16-page digest that's packed with tested Oakite procedures for power-plant maintenance-cleaning—procedures that pay off in thorough cleaning, degreasing, descaling . . . reduced cleaning time . . . increased equipment efficiency. Shows how to save money in steam control systems, electric and diesel power plants.

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Technical Service Representatives Located in Principal Cities of United States and Canada

Cold Weather Starting

(*Continued from page 56*)

points to be heated, and developing heaters that burn diesel fuel.

Heat Addition Before Starting

Perhaps the most desirable arrangement for warming the engine prior to starting would be to apply heat very rapidly by means of a "quick-start" coolant heating system so that even from an initial temperature of —65° F the engine could be warmed to starting temperature in a time of the order of five minutes. Heat release rates of from about 250,000 to 500,000 Btu per hour would be required. Since coolant heaters to do such a job would operate for relatively short periods of time, they could use battery current up to 25 to 50 amperes for starting and operation without excessively discharging the battery if the latter were designed for low-temperature operation.

Circulation of the lubricating oil as a method of carrying heat to the bearings, to the pistons, and to other portions of the engine where the coolant itself does not circulate appears attractive as a method of decreasing the time required for warming the engine. A separate coil for heating the lubricating oil could be mounted in the combustion chamber and a battery-driven pump to circulate it.

Conclusion

Of the various difficulties encountered in the low-temperature starting and operation of diesel engines, the cranking problem is the most serious. Special chemical substances are available to overcome the difficulties of ignition, fuels, lubrication, and cooling at low temperatures, although the supplies of certain of these chemicals may be limited in times of emergency.

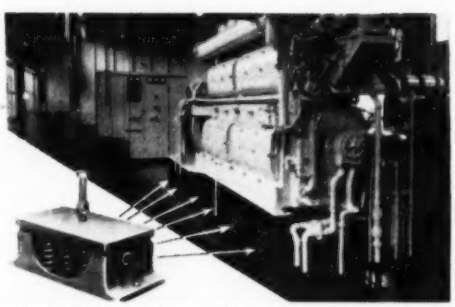
It seems worthwhile in the immediate future to use "quick-start" coolant heating systems to warm diesel engines at temperatures below about —20° F. The considerable amount of development work being done in the United States both by the military and by industry on the low-temperature problems of starting and operating diesel engines gives reasonable assurance that these problems will be solved in a satisfactory manner.

DIESELS for operating **ECONOMY**

The present day trend toward diesels — both for new installations and for replacements — is largely due to operating economy and dependability.

Current installation practice is to mount them on Korfund Vibro-Isolators.

This makes it possible to install diesels *anywhere* with positive assurance that there will be absolutely no transmission of objectionable vibration. Additional benefits include savings from reduction of building and engine maintenance costs, and frequently the elimination of concrete foundations.



This Alco 975 hp. six cylinder turbocharged main generating unit installed on a mooring barge operated by U.S. Army Corps of Engineers, Memphis District, supplies power for their new dragline bank graders. The unit is mounted on Korfund vibro-isolators for smooth operation, and to prevent bearing misalignment due to hull distortion.

Vibration is absorbed by steel springs which provide the finest isolating medium available. Thrusts are controlled by resilient chocks in the four corners.

The result is smoothed, floating operation at all speeds — in marine, mobile, or stationary installations. The cost is low. Ask for Bulletin G-102. Representatives in principal cities.

The Korfund Company, Inc.

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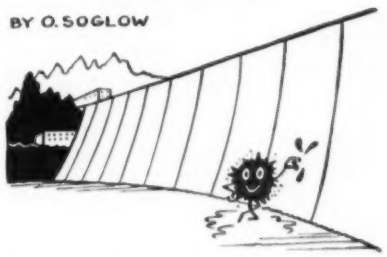
A Few Typical Installations:

Bangor Hydro-Electric Co., Bangor, Me. ..... 6 1425-hp. Nordberg
Lenox Hill Hospital, New York ..... 1 750-hp. Worthington
2 Park Avenue, New York ..... 4 450-hp.; 1 750-hp. Worthington
New Yorker Hotel, New York ..... 1 530-hp.; 1 750-hp. Busch-Sulzer
Namm Department Store, Brooklyn
4 300-hp.; 1 180-hp.; 1 150-hp. Worthington
Macy's, New York ..... 1 700-hp. Alco
Floyd Bennett Field, New York ..... 1 450-hp. Fairbanks-Morse
Prudential Insurance Co., Newark, N. J. ..... 1 700-hp. Baldwin
Lone Star Gas Co., Dallas, Texas ..... 1 400-hp. Cooper-Bessemer (Gas)
Sun Oil Co., Marcus Hook, Pa. ..... 6 250-hp. Ingersoll-Rand (Gas)
Cia Central Argentina De Electricidad, Buenos Aires, S. A.
1 270-hp. Sulzer; 2 540-hp.; 1 560-hp.; 1 700-hp. Deutz

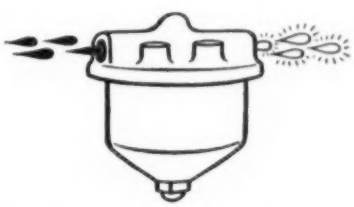
KORFUND for operating **SMOOTHNESS**

AIR-MAZING FACTS

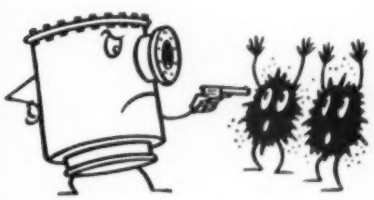
BY O. SOGLOW



DUST FIXES DAM. When 30,000 gallons of water per minute began leaking through the Grand Coulee Dam, engineers plugged the leak with dust! They used bentonite, a volcanic clay dust that holds up to 15 times its own volume of water.



KEEPS OIL SPIC AND SPAN. Air-Maze liquid filters remove abrasive particles from engine lubricants, fuels and hydraulic fluids. "Disc" construction provides many times more net effective filter area than other types of permanent filters. All-metal construction. Like new after cleaning.



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WHETHER YOU BUILD OR USE engines, compressors, air-conditioning and ventilating equipment, or *any device using air or liquids* — the chances are there is an Air-Maze filter *engineered* to serve you better. Representatives in all principal cities, or write Air-Maze Corporation, Cleveland 5, Ohio.

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The Filter Engineers

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SILENCERS
SPARK ARRESTERS
LIQUID FILTERS
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FOR SALE

One Cooper-Bessemer Type FWDR-8T Marine Type 8 cylinder (600 HP at 750 RPM) turbocharged full diesel engine with full complement of auxiliaries including: reversing mechanism, fuel oil filters, lub oil filter cooler and pump, gages, thermometers, governor, alarm signals, Maxim silencer, and air starting system.

This engine was purchased new and placed in operation in June 1948 and has operated approximately 7,400 hours. It has had top quality maintenance, is in excellent condition, and is available because the drive it serves is being electrified.

PRICE: $17,500.00.

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32 Model 671 G.M., 225 HP, 6 cylinder Diesel engines

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(Organizational News Continued from Page 78)

Fairbanks, Morse Elects Vice President

V. H. Peterson, manager of the Railroad Division of Fairbanks, Morse & Co., was elected vice president in charge of railroad sales at a recent meeting of the board of directors

Mr. Peterson has been with the company since 1946. He has had long and varied experience in the railroad field, having been assistant to the president and manager of the New York office of the Baldwin Locomotive Works.

Westinghouse Appointments

Wallace B. Strathdee has been named manager of the marine and industrial departments of Westinghouse Electric Corporation, Boston. A graduate of Tufts, he has been with the corporation since 1927, and has worked in the New England district since 1929. For the past five years he has been district machinery electrification manager.

H. Raymond Benson is the new manager of the transportation department. He started in the company's transportation sales department in the New England district in 1924, and since 1939 has been district maintenance supervisor.

"Cat" Promotion

E. C. Sonneman was recently promoted to assistant export divisional manager of Caterpillar Tractor Company. His new position will be that

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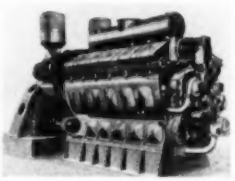

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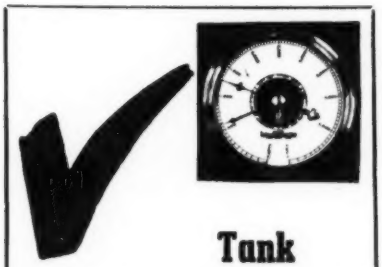

Tank Contents At A Glance

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of assistant manager of the Latin American division, which includes the countries of Central and South America.

Born in Peoria, he joined Caterpillar in 1935, saw service with the Corps of Engineers during World War II, and returned to Peoria in 1945 for two years before going to South America for four years as district representative for the company.

Drake America Vice President

Dennis E. Tiberiis has been appointed vice president of the Drake America Corporation. The corporation owns and operates the Hill Diesel Engine Corporation, Lansing, Mich., of which he is also a vice president. A veteran of 25 years in international trade and marketing, Mr. Tiberiis has been associated with Drake for the past five years.

Worthington Appointment

Edward Barwell has been named industrial relations coordinator of Worthington Pump and Machinery Corporation. He will assist Mr. L. C. Ricketts, vice president in charge of manufacturing, in industrial relations and personnel policies.

Mr. Barwell served on the Industry Tri-Partite Panel of the National War Labor Board from 1942 till 1945. He has been associated with Crocker-Wheeler Electric Manufacturing Company since 1926.

I-H Retirement

After 47 years of service with International Harvester, D. B. Baker, manager of Industrial Power engineering, recently retired.

Association with the industrial power division since its inception, he was instrumental in the development of the TD-24. He was one of the engineers assigned to work with the German engineer, Dr. Claude Dornier, in designing the company's diesel engine, and the fuel injection system now used in the I-H diesel engines was another of his accomplishments, as were many other original tractor and engine designs and improvements.

FOR SALE

1--New Sheppard Diesel generating set 36KW-EM Generator 120/208 Volt 3 phase 60 cycle 4 wire with panel board. $4250.00

1—New Sheppard Diesel Model 14 Power unit with clutch, 3½ HP. $500.00

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Type	HP Cont.	RPM	BORE In.	STROKE In.	LENGTH In.	WIDTH In.	HEIGHT* In.	WEIGHT Lbs.
AV1	3/6	1000-1800	3.15	4.33	29.75	20.375	36.625	406
AV2	6/12	1000-1800	3.15	4.33	36.5	20.625	36.625	598
B2T	12/18	1000-1500	4.33	4.33	33	24	41.375	1198
B3T	18/27	1000-1500	4.33	4.33	39.125	24	41.75	1477
B4T	24/36	1000-1500	4.33	4.33	45.75	24	41.25	1737

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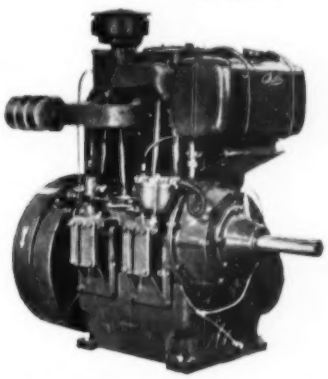
Type	HP Cont.	RPM	BORE In.	STROKE In.	LENGTH In.	WIDTH In.	HEIGHT In.	WEIGHT Lbs.
AVA1	3/5.25	1000-1800	3.15	4.33	29.75	21	30.125	390
AVA2	6/10.5	1000-1800	3.15	4.33	36.5	21	31.75	558



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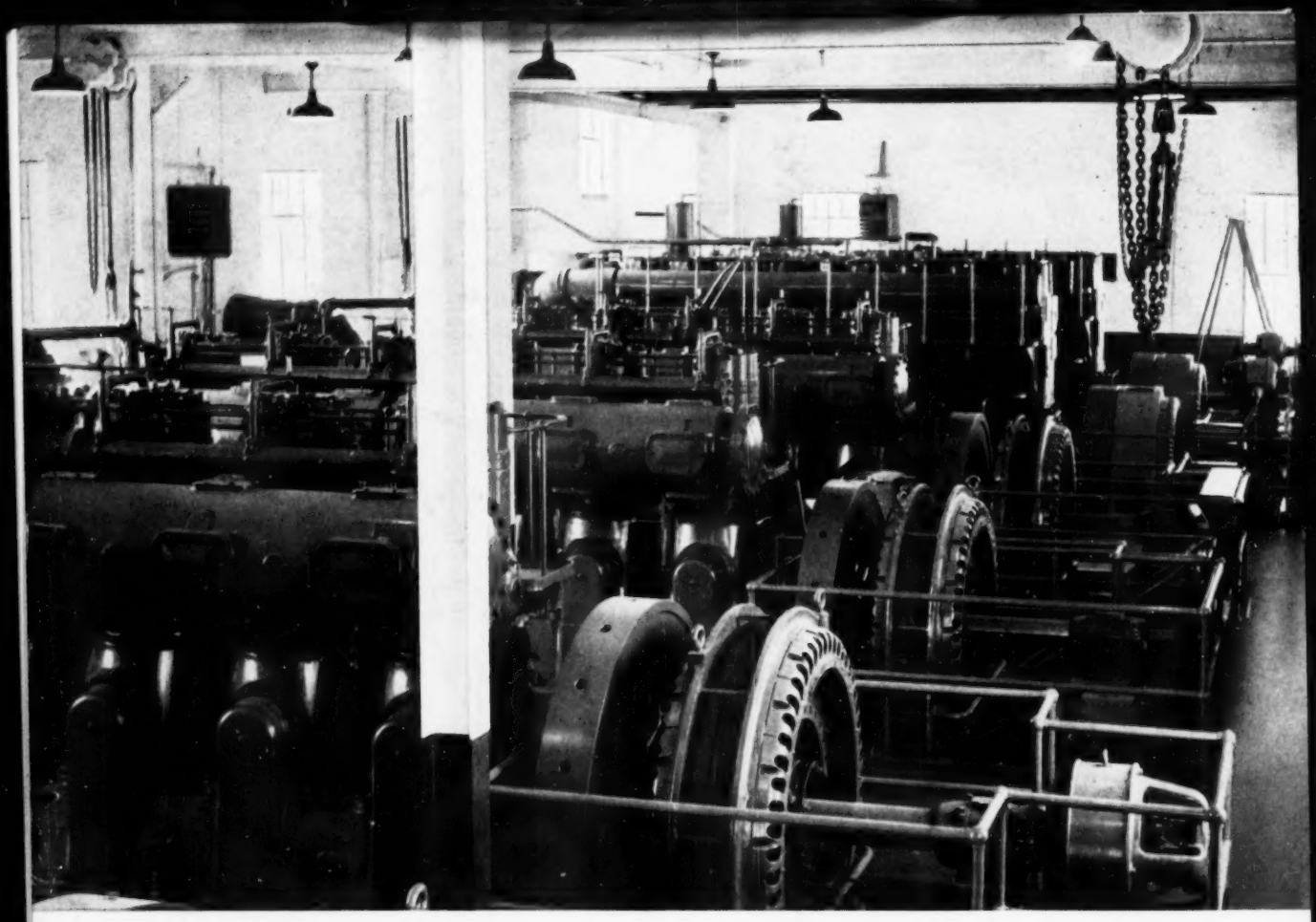

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The experience of this diesel operator indicates how STANDARD HD Diesel Oil will help you eliminate costly maintenance and operating problems. A Standard Oil lubrication specialist can show you many plants where STANDARD HD gives this cost-reducing performance.

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